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CONTENTS

TRANSACTIONS

ABSTRACTS

(Papers, of which the title only is cited, are marked with an *)

On the change of flora in Eastern Asia since Tertiary Period (I).

The clay or lignite beds flora in Japan with special reference to the *Pinus trifolia* beds in Central Hondo

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With plates IV-VII and 21 text-figures

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Contents

I. Introduction

In the suburbs of Seto, Prefecture of Aiti, and Tazimi, Prefecture of Gihu, there are nearly hundred places excavated for the purpose of getting the clay used for porcelain and fire bricks. The clay is acidic in nature and rich in alumina but poor in ferric oxide and includes some lignite layers so that it is usually called „Kibusi" (lignite blocks) clay in the central region of Honsyu. It is rich in floral remains, but not in faunal remains. *Pinus trifolia* is the most remarkable one of the former, as I reported previously (39).

In the present paper I intend to report on the floral remains associated with *Pinus trifolia* in the clay layer and the distribution of these remains studied from similar clay or lignite beds throughout Japan.

The remains hitherto found in the beds came up to 83 species, 40 species of which are extinct from Japan to-day. Among the latter there

Fig. 1. Map showing the localities of the fossil beds with some geological features.
A Hatagoya; B Komanba; C Tamodaira; D Mihune; E Obata; F Akazu; G Itirizuka; H Inzyo; I Itinokuraguti; J Simoiguta; K Osusawa; L Itinohora; M Hosono. (Tajimi=Tazimi).
1. Granite and other plutonic rocks.
2. Hornstone and other paleozoic rocks.
3. Clay on the tuff.
4. Clay.

are two new genera, *Metasequoia* and *Hemitrapa* and 19 new species and 3 new varieties. There are also 9 genera now confined to the central and southern China and North America. The ecological condition of the beds and the mode of deposition of the Kibusi clay are also discussed.

I wish to offer my heartly thanks to Prof. K. KORIBA for much helpful criticism and encouragement. Further I am indebted to Prof. J. MAKIYAMA and Assistant Prof. J. TAKUBO, for their valuable suggestions upon geological questions. In this study I am greatly obliged to the Imperial Academy of Japan, for valuable financial assistance.

II. General part

1. The site and structure of the beds

The remains of *Pinus trifolia* were found up to date from 12 stations situated around the Mt. Sanage and Mt. Mikuni, where the cliff of the clay or lignite beds were excavated (Pl. IV, Fig. 1, A–B). The name of stations together with the associated remains are as follows:

TABLE 1

	Localities	Altitude of the fossil bed (m)	Remains of *Pinus trifolia*	Associated remains	
				Number of species	Representative species
A	Hatagoya in Mizuka ni, Suetyo, Pref. Gihu	440	Cone (A), Leaf (A)	27	*Glyptostrobus, Keteleeria, Hemitrapa*
B	Komanba in Hara, Turuokamura, Pref. Gihu	500	Cone (C)	?	?
C	Tamodaira in Huziokamura, Pref. Gihu	140	Cone (A)	8	*Brasenia, Spondias, Nyssa*
D	Mihune in Sanagemura, Pref. Aiti	140	Cone (R)	1	*Glyptostrobus*
E	Obata in Homimura, Pref. Aiti	160	Cone (A), Leaf (C)	24	*Glyptostrobus, Nyssa, Hemitrapa*
F	Akaza in Seto, Pref. Aiti	180	Cone (C), Leaf (A)	9	*Glyptostrobus, Brasenia, Hemitrapa*
G	Itirizuka in Seto, Pref. Aiti	170	Cone (R), Leaf (A)	17	*Glyptostrobus, Pseudolarix, Trapella*
H	Inzyo in Seto, Pref. Aiti	160	Cone (R)	43	*Pseudolarix, Carya, Liquidambar*

TABLE 1 (*Continued*)

	Localities	Altitude of the fossil bed (m)	Remains of *Pinus trifolia*	Associated remains	
				Number of species	Representative species
I	Itinokuraguti in Tazimi, Pref. Gihu	160	Cone (R), Leaf (C)	25	*Glyptostrobus, Sequoia, Nyssa, Liquidambar*
J	Simoiguta in Tazimi, Pref. Gihu	140	Cone (R), Leaf (R)	26	*Glyptostrobus, Sequoia, Stephania, Fortunearia*
K	Osusawa in Tokitutyo, Pref. Gihu	160	Cone (R)	31	*Cunninghamia, Sequoia, Metasequoia, Hemitrapa*
L	Itinohora in Takayama, Tokitutyo, Pref. Gihu	160	Cone (R)	26	*Glyptostrobus, Sequoia, Pseudolarix, Eucommia*
M	Hosono in Turusatomura, Pref. Gihu	460	?	6	*Glyptostrobus, Sequoia, Brasenia, Fortunearia*

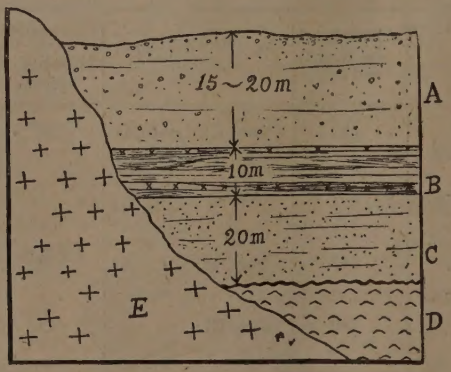

Fig. 2. Profile of the fossil beds (Diagrammatic).

A Gravel and sand bed.
B Clay bed with lignite seams
×× the seat of plant remains.
C Sandy clay or sand bed.
D Tuff (Marine Miocene beds).
E Granite.

Generally the constitution of the beds is nearly the same on the structure all through the stations as shown in Fig. 2. They are mounted on granite with intermittent layers of sand or clay, or the tuff-layer

in the northern region of the slope. The upper part of the clay or lignite beds are covered irregularly by sandy layer about 15–20 m in thickness.

2. Remains

EXPLANATION OF THE ABBREVIATIONS

Parts of remains:
F fruit (including cone); S seed; M male cone;
L leaf (including frond); Sh shoot; Sp spine;
B branch ; T trunk; R rhizome;
H halm

Occurrence:
A abundant; C common; R rare

Distribution of the species or their allies at present
A North America
C China: SC Southern and CC Central China
J Japan: SJ Southern and CJ Central Japan
O Japan and China: SO Southern part of the regions

Gothic type: Species extinct or not found in wild state in Japan.
For abbreviation of localities, see table 1.

As the remains there are found following 83 species belonging to 62 genera and 37 families, among which 40 species (48%) are extinct from Japan to-day or not found in wild state in Japan.

TABLE 2

	Localities	Part of remains	Distribution
a Pteridophyta			
Osmundaceae			
1 *Osmunda* cf. *japonica* THUNB. (Fig. 5 A–B)	K	L(A)	O
b Gymnospermae			
Pinaceae			
2 *Keteleeria Davidiana* BEISSNER (Pl. IV H–K, Fig. 5 C–I)	A,E,J	F,M,S,Sh,L	SO
3 *Picea* cf. *Maximowiczii* REGEL (Fig. 5 J)	K,L	F(R)	CJ
4 *Pinus Fujiii* MIKI (Pl. IV G, Fig. 5 K–M)	A,E,I,K	C(A),L	J
5 *Pinus trifolia* MIKI in Bot. Mag. Tokyo **53**, 239 Pl. 4, fig. 3	A–L	F,S,M,L,B	A
6 *Pseudolarix Kaempferi* GORD. (Pl. IV C–F, Fig. 6 A–E)	G,H,L	F,S,L,B	CC
7 *Tsuga oblonga* n. sp. (Pl. IV L, Fig. 6 F–H)	I,K,L	F(A),B	A
Taxodiaceae			
8 *Cunninghamia Konishii* HAYATA (Pl. V G, Fig. 7 A–B)	K	Sh(C)	SO

TABLE 2 (*Continued*)

		Localities	Part of remains	Distribution
9	*Glyptostrobus pensilis* KOCH (Pl. V H, Fig. 7 C-F)	A,D,E,G,I-M	F,S,Sh(A)	SC
10	*Metasequoia disticha* n.g.n. com. (Pl. V A-C, Fig. 8 A-G)	K	F,Sh,B	?
11	*Metasequoia japonica* n.g.n. com. (Pl. V D, Fig. 8 Ab, H)	K	F(R)	?
12	*Sequoia sempervirens* ENDL. (Pl. V Cb, E-F, Fig.7 G-J)	I-M	F,S,Sh,B(A)	A
c	Angiospermae			
	Dicotyledoneae			
	Salicaceae			
13	*Salix amygdalis* L. var. (Fig. 9 A-B)	H,K	L(R)	J
	Juglandaceae			
14	*Carya nanacarpa* n. sp. (Pl. VI Dc, Fig. 9 E)	I	F(C)	A
15	*Carya cathayensis* SARG. (Pl. VI Db, Fig. 9 D)	E,H,L	F(C)	CC
16	*Carya ovatocarpa* n. sp. (Pl. VI Da, Fig. 9 C)	A,H	F(R)	?
17	*Juglans cinerea* L. (Fig. 9 F)	H	F(R)	A
18	*Juglans* cf. *rostrata* GÖPPERT (Fig. 9 G)	H	F(R)	?
	Betulaceae			
19	*Alnus japonica* S. et Z. (Fig. 10 G)	A	F(C)	J
20	*Betula adstigmata* n. sp. (Fig. 10 A-B)	H,K	F(C),L	J
21	*Carpinus carpinoides* MAKINO (Fig. 10 C,F)	H,K	F,L(C)	J
22	*Carpinus Tschonoskii* MAX. (Fig. 10 D-E)	E,H,L	F,L	J
23	*Corylus ligniatus* n. sp. (Fig. 10 H)	H	L(C)	?
	Fagaceae			
24	*Fagus japonica* MAX. (Fig. 11 A, Ca)	A,C,E,G,I,M	F(A),S,L	J
25	*Fagus ferruginea* AIT. (Fig. 11 B,Cc)	H,K	F,S,L	A
26	*Quercus acutissima* CARR. (Fig. 12 D)	H	L(A)	O
27	*Quercus* cf. *gilva* BL. (Fig. 12 G,H)	H,K	L(R)	O
28	*Quercus* cf. *stenophylla* MAKINO (Fig. 12 E-F)	A,I	F,L	J
29	*Quercus varia ilis* BL. (Fig. 12 A-C)	A,H,L	F(A),S,L	O
	Ulmaceae			
30	*Zelkova* cf. *Ungeri* KOVAT. (Fig. 12 I)	H	L(R)	O
	Nymphaeaceae			
31	*Brasenia Schreberi* GMEL. (Pl. VII B, Fig. 13 F)	A,C,E,F,M	S(A)	O
	Menispermaceae			
32	*Sinomenium acutum* REHD. et WILS. (Fig. 13 H)	G	S(R)	O
33	*Stephania Dielsiana* WU (Pl. VI C, Fig. 13 G)	E,I,J	S(A)	SC
	Magnoliaceae			
34	*Magnolia obovata* THUNB. (Fig. 13 A)	H,I,L	S(R)	O
35	*Schizandra megasperma* n. sp. (Pl. VI G, Fig. 13 C)	L	S(R)	O

TABLE 2 (*Continued*)

	Localities	Part of remains	Distribution
Lauraceae			
36 *Benzoin umbellatum* REHD. (Fig. 13 I–K?)	E,H	L,S(C)	O
Hamamelidaceae			
37 *Fortunearia sinensis* REHD. et WILS. (Fl. VI F, Fig. 14 D)	E,H–M	F,S(A)	CC
38 *Hamamelis parrotioidea* n. sp. (Fig. 13 E)	A,C,E,G	F,S	O
39 *Liquidambar formosana* HANCE (Pl. VI A-B, Fig. 14 A–C)	H–J	F(A),L	O
Eucommiaceae			
40 *Eucommia ulmoides* OLIVER (Pl. VI E, Fig. 14 F)	L	F(R)	CC
Rosaceae			
41 *Amelanchier* cf. *asiatica* ENDL. (Fig. 15 A–B)	H	L(R)	O
Leguminosae			
42 *Dalbergia* sp. (Fig. 15 G)	H	L(R)	C
43 *Gleditschia* cf. *macracantha* DESF. (Fig. 15 E–F)	H	F,C),Sh	SC
44 *Wistaria ligniata* n. sp. (Fig. 15 C–D)	H	F,L(C)	O
Rutaceae			
45 *Fagara ailanthoides* ENGL. (Fig. 16 E)	J	S(R)	SJ
Euphorbiaceae			
46 *Mallotus protojaponicus* n. sp. (Pl. VI H, Fig. 16 A–C)	A,H	S,L	O
Buxaceae			
47 *Buxus japonica* MUEL. (Fig. 16 D)	L	L(C)	O
Anacardiaceae			
48 *Spondias axillaris* ROXB. (Pl. VI Ib, Fig. 16 Jc–e)	A,C,H	F(C)	SO
var. *polymeris* nov (Pl. VI Ia, Fig. 16 Ja–b)	A,K	F(C)	
var. *stenocarpa* nov (Pl. VI Ic, Fig. 16 Jf–i)	H,I	F(C)	
Celastraceae			
49 *Tripterygium multipterium* n. sp. (Pl. VII A, Fig.16 G)	H,I	F(C)	O
Staphyleaceae			
50 *Euscaphis japonica* PAX (Fig. 16 H,I)	I,J	S(C)	O
Aceraceae			
51 *Acer rubrum* L. var. *ligniatum* nov. (Fig. 17 A)	H,K	L(C)	J
52 *Acer palmatum* THUNB. (Fig. 17 B–Cd)	A,H	F,L	J
Sabiaceae			
53 *Meliosma* cf. *rigida* S. et Z. (Fig. 17 H)	A,G,J	S	J
54 *Sabia japonica* MAX. (Fig. 17 D–E)	H,I,J,L	S(C),L	SJ
Rhamnaceae			
55 *Berchemia racemosa* S. et Z. (Fig. 17 F)	A	F(R)	O
56 *Paliurus nipponicus* MIKI (Fig. 17 G)	A,E,H	F,Sh	SO

TABLE 2 (*Continued*)

	Localities	Part of remains	Distribution
Vitaceae			
57 *Cissus japonica* WILLD. (Fig. 17 J)	J,L	S(R)	O
58 ***Cissus megasperma*** n. sp. (Pl. VII C, Fig. 17 K)	A,C,G,H,K	S(C)	?
59 *Vitis* cf. *Thunbergii* S. et Z. (Fig. 17 I)	A,J,K	S(R)	J
Tiliaceae			
60 *Tilia kiusiana* MAKINO et SHIRAS. (Fig. 18 A)	H	L(C)	SJ
61 *Tilia japonica* SIMK. (Fig. 18 B–C)	H	L(C),F	J
Theaceae			
62 *Camellia japonica* L. (Fig. 18 D)	H	F,S(R)	O
63 *Stewartia monadelpha* S. et Z. (Fig. 18 E,G)	H–J	F(C)	J
64 *Stewartia pseudocamellia* MAX. (Fig. 18 F)	H	F(R)	J
Hydrocaryaceae			
65 ***Hemitrapa trapelloidea*** n.g.n.sp. (Pl. VII D, Fig. 19 D)	A,E,F,H,K	F(A)	?
66 *Trapa incisa* S. et Z. (Fig. 19 C)	I,M	F(C)	O
67 ***Trapa mammillifera*** MIKI (Pl. VII E, Fig. 19 A–B)	A,E,G,H	F(A)	O
Nyssaceae			
68 ***Nyssa pachycarpa*** n. sp. (Pl. VII Ka, Fig. 18 E)	E,I	F(A)	?
69 ***Nyssa sylvatica*** MARSH. (Pl. VII Kb, Fig. 19 F)	A,C,E,H–L	F(A)	A
Cornaceae			
70 *Cornus controversa* HEMSL. (Fig. 19 H)	K	F(R)	J
Symplocaceae			
71 *Symplocos lancifolia* S. et Z. (Fig. 20 J)	K	F(R)	SJ
72 *Symplocos myrtacea* S. et Z. (Pl. VII I, Fig. 20 I)	A,E,F,G,J,K	F(C)	SJ
73 ***Symplocos tricarpa*** n. sp. (Pl. VII J, Fig. 20 H)	A,J	F(R)	SJ
Styracaceae			
74 ***Meliodendron nipponicum*** n. sp. (Pl. VII L, Fig. 20 F)	H	F(A)	SC
75 ***Styrax laevigata*** n. sp. (Pl. VII G, Fig. 20 C)	E,I,K	S(C)	O
76 *Styrax obassia* S. et Z. (Pl. VII Hb, Fig. 20 B)	J,L	S(A)	O
77 ***Styrax rugosa*** n. sp. (Pl. VII Ha, Fig. 20 D–E)	A,C,E,F–M	S(A),L	O
78 *Styrax Shiraiana* MAKINO (Pl. VII Hc, Fig. 20 A)	J,L,M	S(A)	J
Oleaceae			
79 *Fraxinus* cf. *japonica* BL. (Fig. 21 C)	H	F(R)	J
80 *Syringa* cf. *amurensis* RUPR. (Fig. 21 A)	H	L(C)	O
Pedaliaceae			
81 *Trapella antennifer* GLÜCK (Pl. VII F, Fig. 21 B)	A,E,G–I	F(A)	J
Caprifoliaceae			
82 *Viburnum japonicum* SPRENG. (Fig. 21 E)	J	S(R)	SJ
Monocotyledoneae			
Gramineae			
83 *Phyllostachys* sp. (Fig. 21 H–I)	H,L	H,L	O

3. Characters of the remains

a. The mode of occurrence

Some species such as *Glyptostrobus, Sequoia, Keteleeria* are found plentifully in many localities but only single specimen was found in each of *Eucommia, Berchemia* and *Fagara* in one of the excavations.

Most of the beds contain remains of fresh water plants but are destitute of herbaceous marshy plants. Most of them contain temperate elements such as *Picea, Betula* and *Carpinus* intermingled with some subtropical ones as *Glyptostrobus, Spondias* and *Stephania.*

The following 13 species (Table 3) are found in five different localities in the region. They are designated as dominant species in the paper, though it is not certain at present, whether they are really dominant or not, for the remains with vigorous growth or with preservable seeds or fruits should have more opportunities to be met with than others.

TABLE 3

Localities	A	B	C	D	E	F	G	H	I	J	K	L	M
Pinus trifolia	+	+	+	+	+	+	+	+	+	+	+	+	·
Glyptostrobus pensilis	+	·	·	+	+	+	+	·	+	+	+	+	+
Sequoia sempervirens	·	·	·	·	·	+	·	·	·	+	+	+	+
Fagus japonica	+	·	+	·	+	+	+	+	+	·	·	·	+
Brasenia Schreberi	+	·	+	·	+	+	·	·	·	·	·	·	+
Fortunearia sinensis	·	·	·	·	+	·	·	+	+	+	+	·	+
Spondias axillaris	+	·	+	·	·	·	·	+	+	·	+	·	·
Cissus megasperma	+	·	+	·	·	·	+	+	·	·	+	·	·
Hemitrapa trapelloidea	+	·	·	·	+	+	·	+	·	·	+	·	·
Nyssa sylvatica	+	·	+	·	+	·	·	+	+	+	+	+	·
Styrax rugosa	+	·	+	·	+	·	+	+	+	+	+	·	·
Symplocos myrtacea	+	·	·	·	+	+	+	·	·	+	+	·	·
Trapella antennifer	+	·	·	·	+	·	+	+	+	·	·	·	·

b. Distribution

The distribution of the remains in general are shown in Table 4.

Some remains such as *Metasequoia, Hemitrapa, Juglans rostrata* have no intimate relation with the living ones, but most of them are closely related with those of Japan and Eastern China, especially with those of the southern part of the regions. Another interesting fact

worthy of note is that there are many species now confined to the central and southern China such as *Glyptostrobus, Pseudolarix, Keteleeria, Eucommia, Fortunearia, Meliodendron, Stephania Dielsiana* and *Cunninghamia Konishii* (this last one is now confined to Formosa) and a few species now occurring only in North America such as *Sequoia sempervirens, Juglans cinerea* and *Nyssa sylvatica.*

TABLE 4

America	China	Japan	Japan and China	?
6	8	28	33	8

4. Distribution of the dominant species

a. The relationship with the known floral remains in Japan

Dominant species of the beds in their relation to the fossil flora of Japan hitherto known are shown in the following table:

TABLE 5

	Miocene	Pliocene		Pleistocene			Recent
	Sendai (13)	Mogi (16)	Akasi (36)	Katada (37)	Ecoda (37)	Siobara (15)	Azuti (37)
Pinus trifolia	·	·	·	·	·	·	·
Sequoia sempervirens	+	·	·	·	·	·	·
Glyptostrobus pensilis	+	·	·	·	·	·	·
Fagus japonica	·	+	·	·	·	·	·
Brasenia Schreberi	·	·	·	·	·	·	·
Fortunearia sinensis	·	·	·	·	·	·	·
Spondias axillaris	·	·	·	·	·	·	·
Cissus megasperma	·	·	·	·	·	·	·
Hemitrapa trapelloidea	·	·	·	·	·	·	·
Nyssa sylvatica	·	·	·	·	·	·	·
Styrax rugosa	·	·	·	·	·	·	·
Symplocos myrtacea	·	·	·	·	·	·	·
Trapella antennifer	·	·	·	·	·	·	+

As may be seen from the table, the remains here concerned have hardly any relation with most of the floral remains of the adjoing ages, except a few species common with the Miocene flora of Sendai.

b. Other clay or lignite beds in Japan

The clay or lignite beds excavated for the porcelain, fire bricks and tiles are scattered plentifully in Japan. The species enumerated below are remains collected from the following 14 stations (Fig. 3):

Fig. 3. Map showing the localities of excavated clay or lignite beds, where the remains were found.

1. Sanzi in Moriyama, Pref. Tokusima. 2. Doi in Hitoori, Awazi, Pref. Hyogo. 3. Huke in Sennangun, Pref. Osaka. 4. Tutimaru in Sennangun, Pref. Osaka. 5. Sidatani in Simagahara, Pref. Mie. 6. Kaikake, Pref. Siga. 7. Kowa in Titagun, Pref. Aiti. 8. Tokonabe in Titagun, Pref. Aiti. 9. Hanataka near Takasaki, Pref. Gunma. 10. Sayado in Masiko, Pref. Totigi. 11. Koike in Kasimatyo, Pref. Hukusima. 12. Kongosawa in Sendai, Pref. Miyagi. 13. Arigahukuro in Sanbongi, Pref. Migayi. 14. Kitomo in Hunagata, Pref. Yamagata. A. *Pinus trifolia* beds.

TABLE 6

	Localities	Longitude Latitude	Altitude (m)	Associated remains	
				Number of species	Representative species
1	Lignite Beds of Sanzi in Moriyama, Oegun, Pref. Tokusima	134° 23′ 34° 4′	10	11	*Glyptostrobus, Metasequoia, Pterocarya* (Fig. 9 Ha)
2	Lignite Beds of Doi in Hitoori, Awazi, Pref. Hyogo	134° 48′ 34° 20′	60	16	*Glyptostrobus, Sequoia, Buxus, Trapa*
3	Clay Beds of Huke in Sennangun, Pref. Osaka	135° 10′ 34° 19′	60	24	*Glyptostrobus, Pseudolarix, Sequoia, Liquidambar*
4	Clay Beds of Tutimaru in Sennangun, Pref. Osaka	135° 20′ 34° 22′	80	11	*Glyptostrobus, Sequoia, Liquidambar*
5	Clay Beds of Sidatani in Simagahara, Iga, Pref. Mie	136° 3′ 34° 44′	260	32	*Glyptostrobus, Metasequoia, Pterostyrax* (Fig. 20 G), *Pieris* (Fig. 21 G)
6	Lignite Beds of Kaikake in Gamogun, Pref. Siga	136° 16′ 34° 59′	200	5	*Glyptostrobus, Sequoia, Nyssa*
7	Lignite Beds of Kowa in Titagnn, Pref. Aiti	136° 57′ 34° 47′	10	13	*Glyptostrobus, Pseudolarix, Sequoia, Brasenia*
8	Lignite Beds of Tokonabe, Titagun, Pref. Aiti	136° 51′ 34° 53′	10	7	*Glyptostrobus, Sequoia, Sabia, Nyssa*
9	Lignite Beds of Hanataka near Takasaki, Pref. Gunma	138° 57′ 36° 20′	60	14	*Glyptostrobus, Metasequoia, Stephania, Styrax*
10	Clay Beds of Sayado in Masiko, Pref. Totigi	140° 6′ 36° 28′	100	21	*Sequoia, Pseudolarix, Juglans cinerea*
11	Lignite Beds of Koike in Kasimatyo, Pref. Hukusima	140° 55′ 37° 41′	60	7	*Glyptostrobus, Sequoia, Nyssa, Styrax*
12	Lignite Beds of Kongosawa in Sendai, Pref. Miyagi	140° 50′ 38° 14′	100	7	*Sequoia, Tsuga, Nyssa*
13	Lignite Beds of Arigahukuro in Sanbongi, Pref. Miyagi	140° 55′ 38° 31′	22	5	*Glyptostrobus, Sequoia, Euryale* (Fig. 13 E), *Nyssa*
14	Lignite Beds of Kitomo in Hunagata, Mogamigun, Pref. Yamagata	140° 19′ 38° 41′	90	10	*Glyptostrobus, Sequoia, Fagus, Liquidambar, Nyssa*

The distribution of the dominant species from above beds is as in Table 7.

TABLE 7

Localities	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Pinus trifolia	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Glyptostrobus pensilis	+	+	+	+	+	+	+	+	+	·	+	·	+	+
Sequoia sempervirens	·	+	+	+	+	+	+	+	+	+	+	+	+	+
Fagus japonica	·	+	+	·	·	·	·	·	·	·	·	·	·	+
Brasenia Schreberi	·	·	·	·	+	·	+	·	·	·	·	·	·	·
Fortunearia sinensis	·	·	+	·	·	·	·	·	·	·	·	·	·	·
Spondias axillaris	·	·	·	·	+	·	·	·	·	·	·	·	·	·
Cissus megasperma	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hemitrapa trapelloidea	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Nyssa sylvatica	·	+	·	·	+	+	·	+	+	·	+	+	+	+
Styrax rugosa	·	·	+	·	+	·	·	·	+	+	·	·	·	·
Symplocos myrtacea	·	·	+	+	·	·	·	·	·	·	·	·	·	·
Trapella antennifer	·	·	·	·	·	·	+	·	·	·	·	·	·	·

From the data it is clear that *Glyptostrobus*, *Sequoia* and *Nyssa* occur in more than the half of localities, whereas *Pinus trifolia*, *Cissus megasperma* and *Hemitrapa trapelloidea* are confined, so far as it is known, to Seto and Tazimi. The clay beds where *Brasenia* is found, are rich in alumina as in Sidatani in Simagahara, Prov. Iga, and Kowa in Titagun, Prefecture of Aiti, in the latter of which the Kibusi clay is now excavated in some places.

5. Considerations on the mode of occurrence

a. General feature of the deposition

The beds vary tolerably well in thickness, even in closely situated places. They are rich in marsh trees such as *Glyptostrobus* and *Nyssa* and water plants with floating leaves such as *Trapa*, *Trapella* and *Hemitrapa* but destitute of marsh grasses or herbs. These facts indicate that the places of deposition were fluvial plane with luxuriant growth of the marsh trees and with wide range of fluctuation of the water level, so that there could hardly grow either herbaceous marsh plants or submerged water plants.

The places were probably near the seaside protected from direct sea wind as there occurs *Paliurus*, which prefers the interior of inlets. The topography of the beds at that time may be considered as in Fig. 4.

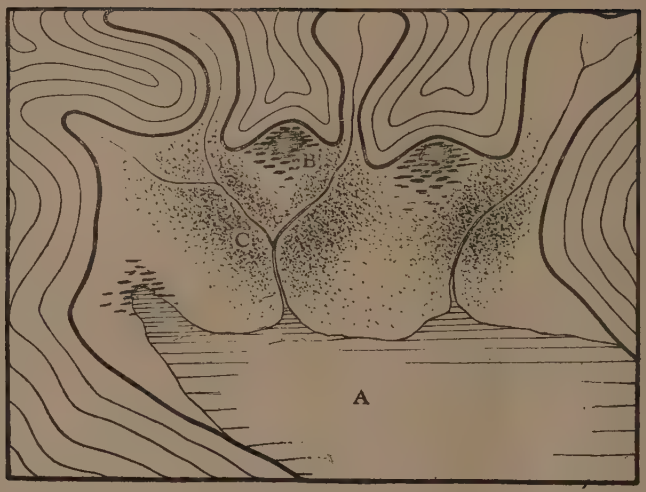

Fig. 4. Map showing the supposed topography of places of deposition.

A Bay.
B Place of depostion of Kibusi clay, the habitat of *Brasenia* surrounded by swamp-forest.
C The place of accumulation of sand.
(Hills are composed mainly of granite).

b. The correlated occurrence of *Brasenia* with the Kibusi clay

The remains of *Brasenia* are associated with the clay rich in alumina as stated above. The amount of alumina in the Kibusi clay here is distinctly greater than in the usual soil and that of silica is also slightly greater than usual, while that of ferric oxide is very small in it (Table 8).

TABLE 8

Material	Constituents			Reference
	Al_2O_3	Fe_2O_3	$S.O_2$	
Kibusi clay from Honyama in Seto	34.84	0.94	48.05	Data from the chemical analysis of the clay for ceramic ware etc. (1923 p. 1–3)
Kibusi clay from Simagahara	32.20	1.54	49.32	,,
Suspended matter of general soil	23.04	12.94	42.58	Average amount from 32 different stations, Japan 22, p. 411)
Colloidal part of general soil	21.97	9.00	37.65	Average amount from 32 different stations, Japan 44, p. 126)

The silica seems to have been derived from granite in the vicinity but the preponderance of alumina and the scarcity of ferric oxide does not seem to be related with mother rocks but with ecological conditions.

The formation of the Kibusi clay makes it conceivable that there could occur *Brasenia* in it, as the habitat of *Brasenia* is usually destitute of direct sedimentation and the bottom has rich accumulation of organic matter. The water seemed also to be more or less acidic.(1) The pH-range of coagulation of aluminium hydroxide is estimated to be 4–6 (30). It is therefore quite natural that some part of colloidal aluminium in the flowing water should have been coagulated in the above habitats, while the ferric oxide was driven out by plenty humous substances as soluble ferrous compound. That the deposition of Kibusi clay is narrow and thin, extending usually only a few hundred meters with 0.5 to 4 m thickness, indicates that the places were formerly ponds or pools alongside of the mountain slope.

6. Consideration on the climate

The remains are found to be closely related with the flora of the southern part of Japan and Oriental Asia. The climate of the beds should be, therefore, nearly in accordance with the above regions, though it differs slightly in the respect that those temperate plants such as *Picea*, *Betula* and *Carpinus* and many Coniferous trees also occurred. The broad-leafed trees of the beds have mostly caudate or acute leaves, characteristic in regions with rich precipitation. The occurrence of *Sequoia* and *Glyptostrobus* indicates also that the climate of the beds was foggy in summer but mild in winter so far as judged from their present habitat.

7. Consideration on the age

The remains so far mentioned are scarcely related with the floral remains hitherto reported in Japan except the Miocene flora of Sendai (13) associated with lignite.

The flora is rich in extinct species of the *Stegodon* Beds in Akasi and other Pliocene beds in Japan (36–37) and also rich in marsh trees but poor in spine or thorn plants (only about 4%). It shows, therefore, an intermediate character between that of the Miocene and the upper Pliocene, so the age of the beds may be considered as the Lower Pliocene.

8. Summary

1. 83 species belonging to 62 genera and 37 families are enumerated from *Pinus trifolia* beds in Central Honsyu, Japan. Among them there

(1) For instance in Mizoroike Pond where *Brasenia* richly grows, the pH-value is estimated to be 5–6 (34).

are 40 species (48%) completely extinct or at least in wild state in Japan today.

2. In the remains there are found 2 new genera: *Metasequoia* and *Hemitrapa* and 19 new species and 3 new varieties: *Tsuga oblonga, Metasequoia disticha, M. japonica, Carya nanacarpa, C. ovatocarpa, Betula adstigmata, Corylus ligniatus, Schizandra megasperma, Hamamelis parrotiodea, Wistaria ligniata, Acer rubrum* var. *ligniatum, Mallotus protojaponicus, Spondias axillaris* var. *polymeris,* and var. *stenocarpa, Tripterygium multipterium, Cissus megasperma, Hemitrapa trapelloidea, Nyssa pachycarpa, Symplocos tricarpa, Meliodendron nipponicum, Styrax leavigata, S. rugosa* and 8 noteworthy genera new to Japan as *Keteleeria, Pseudolarix, Cunninghamia, Fortunearia, Eucommia, Spondias, Nyssa,* and *Meliodendron.*

3. The constitution of the flora has an intimate relation to the flora of the southern Japan and Eastern China. Those genera as *Glyptostrobus, Pseudolarix, Eucommia, Fortunearia, Meliodendron* are confined now to central and southern China and *Sequoia, Juglans cinerea,* and *Nyssa sylvatica* to North America.

4. 13 species of the remains were found in 5 different localities. Among them *Glyptostrobus, Sequoia* and *Nyssa* are distributed in similar beds throughout Japan, but *Pinus trifolia, Cissus megasperma* and *Hemitrapa trapelloidea* were found only at Seto and Tazimi.

5. From the facts that most of the broad-leafed trees have caudate acute leaves and there occur many remains of *Sequoia* and some subtropical elements such as *Spondias, Glyptostrobus* etc., the climate at that age is deduced to be slightly rich in precipitation and foggy in summer and mild in winter.

6. The geological age of the beds is assumed to be the Lower Pliocene, because the flora has some alliance with the Miocene flora, but has more extinct species than the Upper Pliocene of Akasi and of other places.

7. The depositional mode of the clay rich in alumina may be explained by the occurrence of *Brasenia* in the beds, because the pH-range of coagulation of aluminium hydroxide is nearly the same as the habitat water of *Brasenia,* in which the ferric oxide is freed as soluble organic ferrous compounds.

III. Description of the species

1. PTERIDOPHYTA

Osmundaceae

1. ***Osmunda* cf. *japonica* THUNB.** (Fig. 5 A–B)

Many pinnule remains of frond were obtained from Osusawa. Pinnule ovate or oblong-ovate; 8–20 mm wide, 2–3 cm long, veins dichotomous, ending with minute serrations.

This may be identified to the genus and species by the size and shape of pinnules and the dichotomous veins.

2. GYMNOSPERMAE

Pinaceae

The remains are identified to the family by the existence of bract at the base of cone-scale. 5 genera in the beds.

Cone-scales shedded at maturity, leaf deciduous.....*Pseudolarix*
Cone-scales persistent at maturity, leaf evergreen
  Scale with apophyse.....*Pinus*
  Scale without apophyse
    Scale obovate .....*Picea*
    Scale oblong or cordate
      Bract with ciliated margin.....*Tsuga*
      Bract tridentate at apex.....*Keteleeria*

2. ***Keteleeria Davidiana* BEISSN.** (Pl. IV H–K, Fig. 5 C–I)

Some cones, abundant male cones, few twigs and many leaves occurred at Hatagoya, Obata and Simoiguta.

The cone differs from *Abies* by oblong and persistent scales and from *Picea* by ovate scales retuse at distal end. The male cone is identified to the genus by the intermediate size of pollen-grains between *Picea* and *Abies*. The leaves differ from *Abies* by not depressed top and raised midrib. The twigs differ from that of *Picea* by circular concurved scars.

Character of the remains: Cone oblong, 3–4 cm broad, more than 10 cm long; scales ovoid, 2 cm long, 20 mm wide with long tridentate bract; seed fusiform, wing semielliptic. Male cone, 7–8 mm long, 3 mm broad; pollen-grains 100–110 μ wide including wings. Leaf linear, obtuse, 10–20 mm long, 1.6–2.0 mm broad, midrib reaches its apex; twig with circular slightly concurved scars.

Remains of *Keteleeria* were recorded in Europe by KRÄUSEL and KIRCHHEIMER, but the cone of *Keteleeria* cf. *Loehrii* KINK. (KIRCHHEIMER 1939, p. 262) seems to be that of *Pseudotsuga*, because there are broad

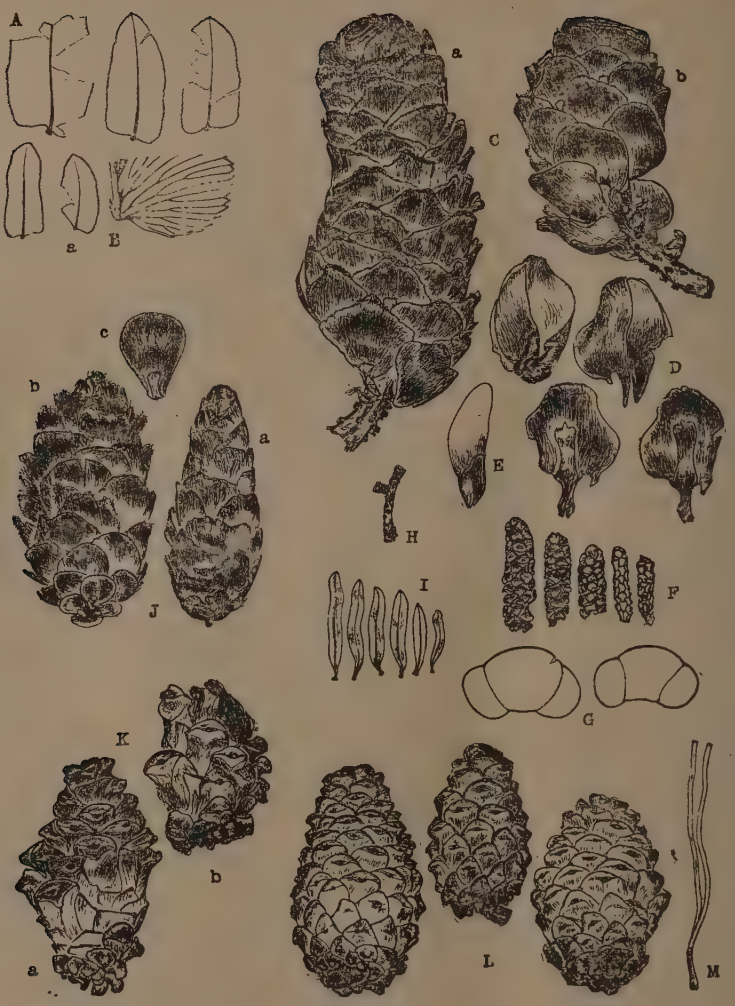

Fig. 5. *Osmunda* and Pinaceae.

A–B Pinnules of *Osmunda* cf. *japonica* THUNB. from Osusawa.
A $\times\frac{2}{3}$, B one part enlarged of Aa, $\times 4$.

C–I ***Keteleeria Davidiana*** BEISSN. from Hatagova.
C Cone $\times\frac{2}{3}$. D Scales $\times 1$. E Seed $\times 1$. F Male cones $\times 2$. G Pollens $\times 153$. H Twig $\times 1$. I Leaves $\times 1$.

J Cones of *Picea* cf. *Maximowiczii* REGEL.
a–b Cones $\times 1$: *a* from Itinohora, *b* from Osusawa, *c* scale from terminal part $\times 1$.

K–L Cones of ***Pinus Fujiii*** MIKI $\times\frac{2}{3}$.
Ka from Hatagoya; Kb from Osusawa; L from Itinokuraguti.

M Leaf of ***Pinus Fujiii*** MIKI $\times 1$, from Itinokuraguti.

thick scales as in *Pseudotsuga*, judged from their figures. Two living species are known from south-eastern China and Formosa. The character of the remains correspond nearly to *K. Davidiana* BEISSN. except the short narrow leaves but as the size of leaf varies in age and position of the tree, the remains are considered as a form of the same.

3. ***Picea* cf. *Maximowiczii* REGEL** (Fig. 5 J)

Three cone remains occurred at Itinohora and Osusawa. Cone oblong-ovoid, 3.5 cm long, 1.5–2 cm wide; scales obovoid, bract small.

The remains were identified to *Picea* by obovate scale with thin margin and by small bract and to the species by small cone and entire scales.

Other localities in Japan: Cliff of Asiyagawa, Pref. Hyogo; Clay Beds of Sayado in Masiko, Pref. Totigi.

4. ***Pinus Fujiii* MIKI** (Pl. IV G, Fig. 5 K–M)

YASUI (1928) 431, fig. 12, pl. 20–21 (80–85, 88–92); MIKI (1939) 244.

Abundant cones and a few leaves were found from Hatagoya, Obata, Osusawa and Itinokuraguti, especially rich in the latter two places. Cone ovate, 4–5 cm long, 2.5–3 cm wide, stipitate, about 10 mm long; scales with thicker apex, basal one of which with hooklike umbo; leaves 2 in a fascicle, 0.7 mm wide, with 6 mm long sheath.

The character of the remain closely resembles that of living species, *Pinus densiflora* S. et Z. and *Pinus Thunbergii* PARL., but it differs from the former by broad scales and extended umbo and from the latter by stipitated cone and hook-like umbo.

5. ***Pinus trifolia* MIKI** in Bot. Mag. Tokyo 53 (1939) 239, Pl. 4, Fig. 3

Descriptions in detail are in my previous paper. Up to the present 12 localities have been found as shown in table 1 and fig. 1.

6. ***Pseudolarix Kaempferi* GORD.** (Pl. IV C–F, Fig. 6 A–E)

A few scales, seeds, branches and leaves were found at Itirizuka, Inzyo and Itinohora. Scale ovate with cordate base, 2–2.5 cm long, 13–15 mm wide with small lanceolate bract; seed elliptic surrounded by semiovate wing, ca. 7–8 mm wide; shoot heteromorphous, short branch 1 cm long, 5 mm wide, annual ring about 1 mm apart; leaf linear, falcate 3–4 cm long, 1.5–2.2 mm broad.

The shedding habit of cone-scale was deduced from their exclusively detached occurrence with perfectly similar shape. The scale differs from *Abies* by robust, ovate form with proximal end nearly parallel to the scale and by small lanceolate bract. The seed differs from associated *Keteleeria* and *Pinus*, as it is parallel to the wing axis and has large wing cells. The short branch is larger and thicker than that of *Larix* and

Fig. 6. *Pseudolarix* and *Tsuga*.

A–E ***Pseudolarix Kaempferi*** GORD.

A Scales ×1: *a–d* from Huke, Pref. Osaka; *e* from Inzyo; *f* from Itirizuka; *g–i* from Sayado in Masiko, Pref. Totigi.

B Seeds×1 excl. *c* ×153: a from Itirizuka; b from Inzyo; *c* wing part enlarged ×153.

C Twigs ×1: *a* from Masiko, Pref. Totigi; *b–d* from Huke, Pref. Osaka.

D–E Leaves from Inzyo: D leaves ×1; e terminal part ×20.

F–H ***Tsuga oblonga*** n. sp.

F Twig from Osusawa: a ×1; b ×10.

G Cones ×1: *a–c* from Osusawa; *d–e* from Itinohora; *f* from Asiyagawa, Pref. Hyogo; *g* from Itinokuraguti; *h* from Kongosawa, Pref. Miyagi.

H Scales ×2: *a* from Osusawa; *b* from Kongosawa.

distinctly constricted by annual rings. The leaf differs from *Larix* by cuticulated serration on the top of margin and by long and broad size. The remains identified to the living one by having the closely related characters.

This monotypic genus is confined now to central region of China, about 1000 m above the sea level but the fossil remains were recorded from the Tertiary in Europe by FLORSCHÜTZ.

Other localities in Japan: Clay Beds of Huke and Yamanakasinke in Sennangun, Pref. Osaka; Lignite Beds of Kowa, Pref. Aiti; Clay Beds of Sayado in Masiko, Pref. Totigi.

7. ***Tsuga oblonga* n. sp.** (Pl. IV L, Fig. 6 F–H)

Cones and twig are found from Itinokuraguti, Osusawa and Itinohora, especially rich in Osusawa. The remain may be referred to the genus by the small cone with ciliated bract on the scale and the twig by marked cusion-like projections.

Living species in the genus are found in northern hemisphere except Europe, though the remains were recorded there from the Tertiary (SZAFER p. 82). The shape of the scale resembles *Tsuga heterophylla* SARG. and *Tsuga caroliniana* ENGELM. in America but it differs by reflexed margin of scales.

Characters: Cone oblong ovate, 1.5–2.5 cm long, 1 cm wide; median scales oblong, 10–11 mm long, 6–7 mm broad, reflexed at the margin; bracts ciliate at the margin. Twig 0.7 mm thick with cushion-like projection of leaf-scars.

Other localities in Japan: Cliff of Asiyagawa, Pref. Hyogo and probably the same species in the Lignite Bed of Kongosawa in Sendai, Pref. Miyagi (Fig. 6 Gh-k).

Taxodiaceae

The remains were recognized to belong to the family by the cone, in which the seed-scale unites to the bract. Four genera in the beds.

Arrangement of cone-scales and leaves is spiral
- Leaf with serration ..... *Cunninghamia*
- Leaf without serration
  - Scale separated to bract and seed-scale at the upper part.. *Glyptostrobus*
  - Scale not separated to bract and seed-scale at the upper part. ..... *Sequoia*

Arrangement of cone-scales and leaves is decussate..... *Metasequoia*

8. ***Cunninghamia Konishii* HAYATA** (Pl. V G, Fig. 7 A–B)

A few foliaged shoots occurred at Osusawa. The remains identified to the genus by the spiral arrangement of the leaves, decurrent on the

Fig. 7. Taxodiaceae.

A–B ***Cunninghamia Konishii*** HAYATA.
A Foliaged shoots ×1: *a–c* from Osusawa; *d* from Asiyagawa, Pref. Hyogo.
B Cone ×1 from Asiyagawa, Pref. Hyogo, *b* scale from terminal part.

C–F ***Glyptostrobus pensilis*** KOCH.
C Cones from Itirizuka ×1.
D Seeds from Itirizuka ×2.
E–F Foliaged shoots ×1: E from Itirizuka, F from Osusawa.

G–J ***Sequoia sempervirens*** ENDL.
G Foliaged shoot from Osusawa ×1.
H Leaf: *a* top ×10; *b* arrangement of stomata on leaf ×43; *c* stomata ×333.
I Cones ×1: *a–c* from Simoiguta; *d–e* from Osusawa; *f* from Sidatani, Pref. Mie.
J Seeds from Sidatani, Pref. Mie ×2.

stem and spreading 2-ranked; leaf linear or lanceolate, with serration at the margin.

Two species of the genus exist now in southern China and Formosa. The remains were identified to be *C. Konishii* endemic in Formosa by short and striate leaves and by mixing of tetragonal leaves.

Other localities in Japan: Lignite Beds of Kowa in Titagun, Pref. Aiti; Clay Beds of Oisendo in Hukakusa, Pref. Kyoto; Cliff of Kyusenro in Narasaka, Pref. Nara and Cliff of Asiyagawa, Pref. Hyogo in which latter occurred an incomplete cone, identified to the species by the style of the scale rectangular to the cone axis (Fig. 7 B).

9. ***Glyptostrobus pensilis*** KOCH (Pl. V H, Fig. 7 C–F)

Glyptostrobus europaeus HEER in ENDO and OKUTSU (1936) 138, fig. 1–3; ENDO (1939) 336, pl. 1 fig. 14.

Callitris japonica ENDO (1934) 374.

Remains of cones, seeds and foliaged shoots occurred abundantly at Hatagoya, Mihune, Obata, Itirizuka, Itinokuraguti, Simoiguta, Osusawa, Itinohora and Hosono, especially rich in Itirizuka, Simoiguta and Hosono.

The cone identified to the genus easily by its obovate form, and by the scales arranged spirally and arising from one point near the base. The upper part of seminiferous scale has no conglutination between the bract and seed scale, the former of which is free and recurved, and the latter with ca. 10 furrows. The foliaged shoot has heteromorphic leaves viz. long-leafed deciduous short branches and short-leafed *Callitris*-like shoots.

The cone has been referred to *Glyptostrobus europaeus* by ENDO and OKUTSU on account of somewhat longer and distinctly furrowed seminiferous scales than the living. At a glance the character seems to be important, but in tuffaceous remains the measuring of the basal part, especially the scale radiating from basal one point is difficult. *Callitris japonica* ENDO seems to be a winterung shoot. Though somewhat alike to *Callitris*, it may be reduced to the genus by the coexistence of young cones.

The remains in Japan are identified to a form of the living one because there is no separable character. The species exists now only in southeastern China, though the remains of the genus were reported in the northern hemisphere from Cretaceous to Tertiary.

The cone remains associate usually with abundant twigs as in living one which sheds long leafed short branches and cone bearing branches in autumn.

The locality hitherto recorded in Japan was only from Sendai, but it is very common in lignite or clay beds throughout Japan: Lignite Beds of Sanzi in Moriyama, Oegun, Pref. Tokusima; Lignite Beds of

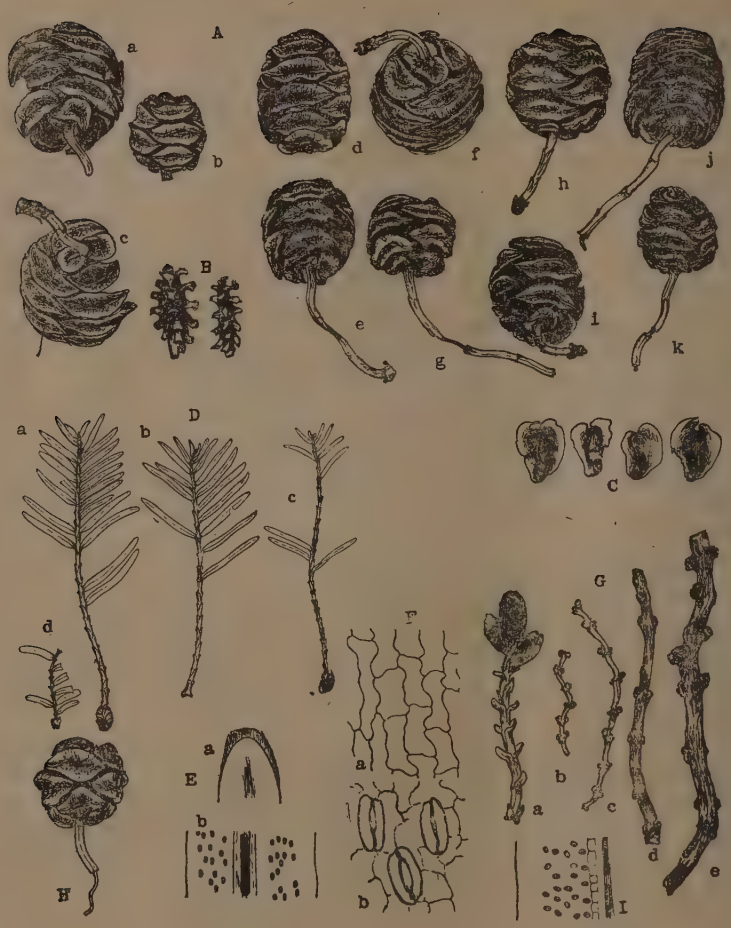

Fig. 8. *Metasequoia* excl. I.

A–G (excl. Ab) ***Metasequoia disticha*** **n. g.** n. com.
- A Cones: *a* from Osusawa, *c* from Hanataka, Pref. Gunma, *d–k* from Hasimoto, Pref. Wakayama ×1.
- B Axial parts of Cone ×1 from Sidatani, Pref. Mie.
- C Seeds from Sidatani, Pref. Mie ×2.
- D Foliaged shoots from Osusawa ×1.
- E Leaf from Osusawa: *a* top ×10; *b* arrangement of stomata ×43.
- F Epidermis of the leaf: *a* from upper side ×233; *b* stomata from underside ×333.
- G Twigs: *a* young terminal shoot from Osusawa ×2; *b–c* two years old shoot from Hanataka, Pref. Gunma ×1; *d–e* shoot from Hasimoto, Pref. Wakayama ×1.

Ab, H ***Metasequoia japonica*** n.g. n. com. from Osusawa ×1.

I Arrangement of stomata on the living leaf of *Taxodium distichum* RICH. ×43.

Doi in Hitoori, Awazi, Pref. Hyogo; Clay Beds of Huke and Tutimaru in Sennangun, Pref. Osaka; Clay Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Kusuhara near Seki, Pref. Mie; Lignite Beds of Kaikake, Pref. Siga; Lignite Beds of Kowa and Tokonabe in Titagun, Pref. Aiti; Lignite Beds of Hanataka near Takasaki, Pref. Gunma; Lignite Beds of Koike in Kasimatyo, Pref. Hukusima; Lignite Beds of Arigahukuro in Sanbongi, Pref. Miyagi; Lignite Beds of Kitomo in Hunagata, Pref. Yamagata.

***Metasequoia* n. g.** (Pl. V A–D, Fig. 8 A–H)

The remains have usually been referred to *Sequoia* or *Taxodium*, indeed the cone is like that of *Sequoia* and the foliage shoot is somewhat like those of *Taxodium*.

The cones were never found connected to branches, but as the leaf-scars on the peduncle are also distichous, it is conceivable that the cones and the shoots belonged to the same plant. The foliaged shoots seem to be lateral branches shedding in autumn, because their length is usually constant and the proximal end is covered by scaly leaves, although they have no scaly bud on the top and the branches two or more years old have two or more bud scars on the nearly same point as in Fig. 8 Ge.

The cone is distinguished from that of *Sequoia* by the decussate arrangement of scales and by the delicate peduncle having scale leaves at the base. The foliaged shoot differs from *Sequoia* by distichous arrangement of leaves and by the brittle petiole. At a glance the shape of the shoot of fragmental remain seems to be *Taxodium* or *Cephalotaxus* but it differs from *Taxodium*[1] by distichous leaf and parallel arrangement of stomata on it and from *Cephalotaxus* by short delicate shoot without scaly bud at the terminal and by the obtuse top of leaf.

The decussate arrangement of cone-scales is not found in living Taxodiaceae, but a common character in Cupressaceae. The shedding of lateral foliaged shoot with linear leaves is common in *Glyptostrobus* and *Taxodium*. So it is sure that the remains belong to Taxodiaceae but as the characters do not harmonize with those of the living forms, a new genus *Metasequoia* is established.

Character: Cone pedunculate, scale decussate, shield-form; peduncle with distichous scars of leaves and scaly leaves at the base. Shoot deciduous; leaf distichous, linear, obtuse, petiolate; stomata parallel to the midrib.

Two species were distinguished by the number of cone scales.

(1) The arrangement of stomata in *Taxodium* is transversal to the midrib (Fig. 8 I) being exceptional in Coniferae.

10. ***Metasequoia disticha* n. g. n. com.** (Pl. V A–Ca, Fig. 8 A–G)

Sequoia disticha HEER (1876) 63, pl. 12, fig. 2 a, pl. 13, fig. 9–11; NATHORST (1888) 5, pl. 1, fig. 1; MIKI (1937) 306, pl. 8 N-O, fig. 1 E-G.

Sequoia Onukii ENDO (1936) 173 fig. 6.

Taxodium distichum RICH. in FLORIN (1920) 16, 30, pl. 1, fig. 1–2; KONNO (1931) pl. 8, fig. 1–2.

Remains of cone and foliaged shoot were found from Osusawa. Cone elliptic, 15–20 mm long, 1.5–2 cm broad, pedunculate about 1–3 cm long. Scale 3–5 mm high, 11–14 mm broad, number of scale on the cone about 16–20; seed 4–5 mm long, 3–3.5 mm broad including the wings; twig with distichous pectinate leaves. Leaf linear, obtuse, 12 mm long, 1.5 mm broad, stomata parallel to the midrib on the ventral side.

The remains identified to the genus by decussate arrangement of cone scales and distichous arrangement of leaves and to the species by the size and shape of the leaf. This species was described by HEER as *Sequoia disticha*, but after his illustrations he did not note the scale leaves on the base of lateral branches. The difference is, however, not essential, because the destitution of scale leaves on the lateral branch of terminal shoot in *Taxodium* and *Sequoia* is quite usual.

Other localities in Japan: Cliff of Asiyagawa, Pref. Hyogo; Clay Beds of Huke and Tutimaru in Sennangun, Pref. Osaka; Clay Beds of Hasimoto, Pref. Wakayama; Clay Beds of Sidatani in Simagahara, Pref. Mie; Cliff of Syurakuen in Titagun, Pref. Aiti; Lignite Beds of Hanataka near Takasaki, Pref. Gunma.

11. ***Metasequoia japonica* n. g. n. com.** (Pl. V D, Fig. 8 Ab, H)

Sequoia japonica ENDO (1936) 172, fig. 5, 7–13; (1939) 337, pl. 23, fig. 15.

A few remains of cone occurred at Osusawa. The cone compressed, 1.2 cm long, 1.2 cm wide. Number of scale about 12–16, decussate; size of scale 10–11 mm broad, 4–5 mm high.

The remain identified to the genus by decussate arrangement of cone-scales and to the species by narrow and fewer number of cone-scales than the former.

12. ***Sequoia sempervirens* ENDL.** (Pl. V Cb, E–F, Fig. 7 G–J)

The remains of cone and foliaged shoot occurred abundantly at Akazu, Simoiguta, Osusawa, Itinohora and Hosono. Cone ovate, 1.5–2 cm high, 1.1–1.5 cm broad; scale shield-form, 6–10 mm broad, 3–4 mm high; seed 2.5–3 mm high, 2–2.5 mm broad including the wings. Leaves heteromorphic, pinnate; linear, mucronate, about 1.5–2 mm broad, 1–1.5 cm long; stomata parallel to the midrib.

The species is identified to the living one by the similarity of cone and foliaged shoot.

The genus is the most common one among Conifers of the Tertiary in the northern hemisphere, though now restricted to the western coast of North America.

One locality in Japan has been recorded already from Sendai but the remains are common throughout the lignite or clay beds in Japan: Lignite Beds of Sanzi in Moriyama, Pref. Tokusima; Lignite Beds of Doi in Hitoori, Pref. Hyogo; Clay Beds of Huke and Tutimaru in Sennangun, Pref. Osaka; Clay Bed of Oiwahara in Kaseyama near Kizu, Pref. Kyoto; Clay Bed of Sagawa near Kasagi, Pref. Nara; Clay Bed of Sidatani in Simagahara, Pref. Mie; Lignite Bed of Kusuhara near Seki, Pref. Mie; Lignite Beds of Kowa and Tokonabe in Titagun, Pref. Aiti; Lignite Beds of Hanataka near Takasaki, Pref. Gunma; Clay Beds of Sayado in Masiko, Pref. Totigi; Lignite Beds of Koike of Kasimatyo, Pref. Hukusima; Lignite Beds of Kongosawa in Sendai, Pref. Miyagi; Lignite Beds of Arigahukuro in Sanbongi, Pref. Miyagi; Lignite Beds of Kitomo in Hunagata, Pref. Yamagata.

3. ANGIOSPERMAE

a. DICOTYLEDONEAE

Salicaceae

13. ***Salix amygdalis* L.** var. (Fig. 9 A–B)

MIKI (1933) 621, pl. I, fig. 4 H; (1937) 310, fig. 3 O–P.

Leaves occurred at Inzyo and Osusawa. The remain identified to the genus by lanceolate leaves with fine glandular incurved serration. One leaf referred to *Salix amygdalis* by its size and shape, but the rest of remains is insufficient for identification.

Juglandaceae

Two genera identified to the family by the shape of endocarp and the embryo cavity.

Shell of nut without cavity, but with remain of stigma and four-ridged striations. ..... *Carya*
Shell of nut with cavity, but without remain of stigma ..... *Juglans*

Carya (Pl. VI D, Fig. 9 C–E)

Abundant remains of endocarp are found from Hatagoya, Inzyo, Itinokuraguti, Osusawa and Itinohora. It is now known that the genus

Fig. 9. Salicaceae and Juglandaceae.

A–B(?) Leaves *Salix amygdalis* L. var.
Aa, Ac and Ba×⅔; Ab and Bb ×10, *a–b* from Inzyo, B from Osusawa.
Ac *Salix* ? from Inzyo.

C–E Nuts of ***Carya*** ×1.
C ***Carya ovatocarpa*** n. sp.: *a–c* from Inzyo, *d* from Hatagoya.
D ***Carya cathayensis*** SARG.: *a–c* from Inzyo, *d* from Itinohora.
E ***Carya nanacarpa*** n. sp.: *a–b* from Itinokuraguti, *c* from Inzyo.

F Nuts of ***Juglans cinerea*** L. ×1, from Inzyo.

G Nut of ***Juglans*** cf. ***rostrata*** GÖPPERT ×1, from Inzyo.

H Nuts of *Pterocarya rhoifolia* S. et Z. ×2: *a* from Sanzi in Moriyama, Pref. Tokusima, *b* from Sayado in Masiko, Pref. Totigi.

were distributed widely in the northern hemisphere during the Tertiary, although now restricted to North America and Central China.

There were found three species distinguished by the shape, size and thickness of the endocarp.

14. ***Carya nanacarpa* n. sp.** (Pl. VI Dc, Fig. 9 E)

A few endocarp remains occurred at Itinokuraguti. The endocarp ovoid, compressed, about 14–15 mm broad, 14 mm high, shell thickness about 1.5 mm, angle slightly distinct above the middle, base round.

The species differs from the other two by its small size.

15. ***Carya cathayensis* SARG.** (Pl. VI Db, Fig. 9 D)

Many endocarp remains occurred at Obata, Inzyo and Itinohora, especially rich at Inzyo. The endocarp ellipsoidal, 1.5–2 cm long, 1.5 cm broad; shell thickness about 1.5–2 mm; stigmal remain distinct, basal point more or less acute.

The remain recognized to the living one which is confined now to Central China by the size, the thickness of the nut wall and its reticulation.

16. ***Carya ovatocarpa* n. sp.** (Pl. VI Da, Fig. 9 C)

A few endocarp remains occurred from Hatagoya and Inzyo. Endocarp ovate, about 2 cm long, 2 cm broad; shell thickness about 3 mm, base round, apex sharp by stigmal remains, four angles obscure.

The remains do not agree with those hitherto reported on account of the broader base of nut.

17. ***Juglans cinerea* L.** (Fig. 9 F)

HAYASAKA (1926) 55, pl. 5; ENDO (1934 b) 345, pl. 42–43; (1934 c) 61, pl. 3; SIMAKURA (1935) 45, fig. 2; MIKI (1937) 310, pl. 8 L, fig. 2 A; ONISI (1940) 19, fig. 2.

A few endocarp remains occurred at Inzyo. The remains identified to the species by large ovoid-oblong nut, acuminate apex, round base, about 5 mm deep with marked sculptures.

Living one of the species is confined to the eastern side of North America, but in the Tertiary throughout the northern hemisphere. The remains in Japan are recorded from many places widely.

Further localities in Japan: Clay Beds of Hasimoto, Pref. Wakayama; Clay Beds of Sagawa near Kasagi, Pref. Nara; Clay Beds of Sayado in Masiko, Pref. Totigi.

18. ***Juglans* cf. *rostrata* GÖPPERT** (Fig. 9 G)

A characteristic nut supplied from Inzyo. Nut fusiform, 2 cm long, 11 mm broad with many indistinct longitudinal striations.

Fig. 10. Betulaceae.

A ***Betula adstigmata*** n. sp. from Osusawa: *a* cone-like strobiles ×1, *b* scales ×2, *c* seeds ×4.

B Leaves of ***Betula*** cf. ***adstigmata*** n. sp. from Inzyo *a*, *b* ×⅔, *b* ×10.

C and F *Carpinus carpinoides* MAKINO from Osusawa excl.
Fb from Inzyo.
C leaves: *a–d* ×⅔, *g* ×4, *h* ×10.
F Fruit and seed: Fa ×1, Fb ×2.

D–E *Carpinus Tschonoskii* MAXIM. from Itirizuka excl.
Dc from Inzyo.
D Fruit and seeds: *a–c* ×1; *d* seeds ×2, E Leaf *a* ×⅔; *b* ×10.

G Cone-like strobile of *Alnus japonica* S. et Z. from Hatagoya *a* ×1; *b* scale ×2.

H Leaves of ***Corylus ligniatus*** n. sp. from Inzyo *a–d* ×⅔, *e* ×10.

The remain is referred to the species by rostrate shape of nut, but it is smaller in shape. Precise identification of the remain is impossible on account of deformation of the inner structure by compression.

Betulaceae

The remains of leaves, strobiles and seeds occurred in the beds. The seed and strobile are identified to the family by the shape of scale and foliaceous involucre. The leaves are identified to the family by alternate simple pinnate veins and by double serration, though the generic identification is hardly possible on account of the similarity of leaf form.

Seed with foliaceous involucre
- Serration of leaf with glandular top ..... *Corylus*
- Serration of leaf sharply pointed ..... *Carpinus*

Seed without foliaceous involucre
- Scale of pistilate ament 3 lobed ..... *Betula*
- Scale of pistilate ament erose or multilobed ..... *Alnus*

19. *Alnus japonica* S. et Z. (Fig. 10 G)

MIKI (1933) 621, pl. L; (1938 a) 216, fig. 2 J; 219, fig. 4 K; 224, fig. 6 I.

Some cone-like strobiles occurred at Hatagoya. The remain is identified to the species by the size and shape of obovate scales.

Further localities in Japan: Lignite Beds of Sanzi in Moriyama, Pref. Tokusima; Clay Beds of Tutimaru in Sennangun, Pref. Osaka; Clay Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Kowa, Titagun, Pref. Aiti; Lignite Beds of Koike, Pref. Hukusima.

20. *Betula adstigmata* n. sp. (Fig. 10 A–B)

A few strobile remains and 2 leaves occurred at Inzyo and Osusawa. Strobile up to 2–2.5 cm long, 5 mm broad; scale 3 lobed, 4 mm long, 3 mm broad; seed obovate 2.5–3 mm long, 2 mm broad, basal part of the stigma unites to marginal part of the wings.

At a glance the character of the seed and bract seems like *Betula grossa* S. et Z. but it differs by narrow persistent strobile and by the half size of seed and bract. Two leaves from Inzyo are referred to the species by the size and obtuse top of the serration.

21. *Carpinus carpinoides* MAKINO (Fig. 10 C, F)

Seed, foliaceous involucre and leaves occurred at Inzyo and Osusawa. Seed elliptic, 3 mm broad, 4 mm long; leaf ovate with double serration and covered by long hairs on the underside.

The remains are referred to the species by oblong seed and the shape of foliaceous involucre.

22. ***Carpinus Tschonoskii* MAX.** (Fig. 10 D–E)

MIKI (1938 a) 232, fig. 12 D; 236, fig. 14 B.

Seeds, foliaceous involucre and leaves occurred at Obata, Inzyo, Osusawa and Itinohora. Foliaceous involucre up to 2 cm long, 7 mm wide, asymmetrical, with 4–5 incised serrations at one side. Seed deltoid, 3–4 mm long, 3–4 mm broad. Leaf ovate, 3 cm broad, 6–7 cm long, serration sharp, petiole about 10 mm long.

The remains are identified to the species by the asymmetrical foliaceous involucre and large deltoid seed.

23. ***Corylus ligniatus* n. sp.** (Fig. 10 H)

Abundant leaves occurred at Inzyo. Leaf oblong lanceolate, somewhat falcate, long pointed, about 6–8 cm long, 2–3 cm broad, oblique at the base, pinninerved, 8–10 paired, serration apiculate.

The shape of leaf seems alike to that of *Corylus Sieboldiana* BL. but is smaller and glabrous.

Fagaceae

Cupules, seeds and leaves occurred in the beds. Identification of the genus were made by special character of the cupule.

Cupule 4-lobed with recurved prickles, seed triangular.....*Fagus*
Cupule not lobed, seed not triangular.....*Quercus*

Fagus (Fig. 11)

Cupules, seeds and leaves occur throughout the beds. The leaf identified to the genus by lateral veins which are curved near the margin. Two species identified from the beds.

24. ***Fagus japonica* MAX.** (Fig. 11 A, Ca)

NATHORST (1888) 227, pl. 9 fig. 3–8; ENDO (1939) 344, pl. 23 fig. 8.

Leaves and cupules occurred from Hatagoya, Tamodaira, Obata, Akazu, Itirizuka, Inzyo, Itinokuraguti and Hosono, especially abundant cupules from Itirizuka and Itinokuraguti. Leaf oblong ovate, about 6 cm long, 2.5–3 cm broad, pointed, cuneate toward the base, lateral vein about 13 pairs ending in mucronate teeth; petiole about 5 mm long. Fruit ovoid, valve about 7–8 mm long, 6 mm broad, with many bristle-like bracts; peduncle narrow about 0.8 mm thick; seed triangular, extrude or nearly the same in length with cupule, winged at margin.

Short petiole, cuneate base of the leaf, slender peduncle and short many bristle-like bracts closely correspond to *Fagus japonica* MAX.

Fig. 11. *Fagus.*

A and Ca *Fagus japonica* MAX. A ×$\frac{2}{3}$ from Inzyo, Ca from Itinokuraguti ×1.
B and Cc ***Fagus ferruginea*** AIT. B ×$\frac{2}{3}$, *a–h* from Inzyo, *i* from Osusawa.
Cc from Osusawa ×1.

25. *Fagus ferruginea* AIT. (Fig. 11 B, Cc)
NATHORST (1883) 43, pl. 4 fig. 11–24; pl. 5 fig. 1–11; pl. 6 fig. 1.

Cupules and leaves occurred at Inzyo and Osusawa. Leaf about 8–9 cm long, 3–4.5 cm broad, ovate, base round, lateral vein 8–12 pairs, ending at curved teeth; petiole 5–10 mm long. Cupule up to 12–14 mm long, 8 mm broad; fruit is as long as cupule.

The serrated character of leaf resembles that of *Fagus Hayatae* PALIB. which occurs in later age but the species differs from it by large leaf and long peduncle of the cupule.

Quercus (Subg. *Cyclobalanopsis*)

Young fruits, seeds, cupules and leaves are found sporadically in the beds. Identification of the cupule is not sufficient, but leaf was identified to the species by its shape and tufted hairs.

26. *Quercus* cf. *gilva* BL. (Fig. 12 G–H)
MIKI (1938 a) 219, fig. 4 N-P.

Incomplete leaf remains occurred at Inzyo and Osusawa. They are identified to the species by their oblanceolate shape with serration and tufted hairs on the underside.

27. *Quercus* cf. *stenophylla* MAKINO (Fig. 12 E-F)

A few leaves and cupules occurred at Hatagoya and Itinokuraguti. Cupule about 1.5 cm broad, 10 mm deep; leaf lanceolate, about 18 mm broad, with serrations at the upper half.

The remain referred to the species by the lanceolate glabrous leaf.

Quercus (Subg. *Cerris*)

28. *Quercus acutissima* CARR. (Fig. 12 D)
MIKI (1933) 623, fig. 1 A-C.

Abundant leaves occurred at Inzyo. Leaf ovate-lanceolate, about 8 cm long, 1.5 cm broad, petiole up to 1.5 cm long, lateral vein about 12 pairs ending with bristle-like serration. The remains identified to a form of the living species by the size and shape of leaf.

Another locality in Japan: Lignite Beds of Doi in Hitoori, Pref. Hyogo.

29. *Quercus variabilis* BL. (Fig. 12 A–C)

Abundant leaves, young fruits and cupules occurred at Hatagoya, Inzyo and Itinohora, especially rich in Inzyo. Leaf ovate-lanceolate, 10 cm long, 2–3 cm broad, lateral veins 12 pairs ending with long acute serration. Petiole 7 mm long with cushion-like swelling at the base.

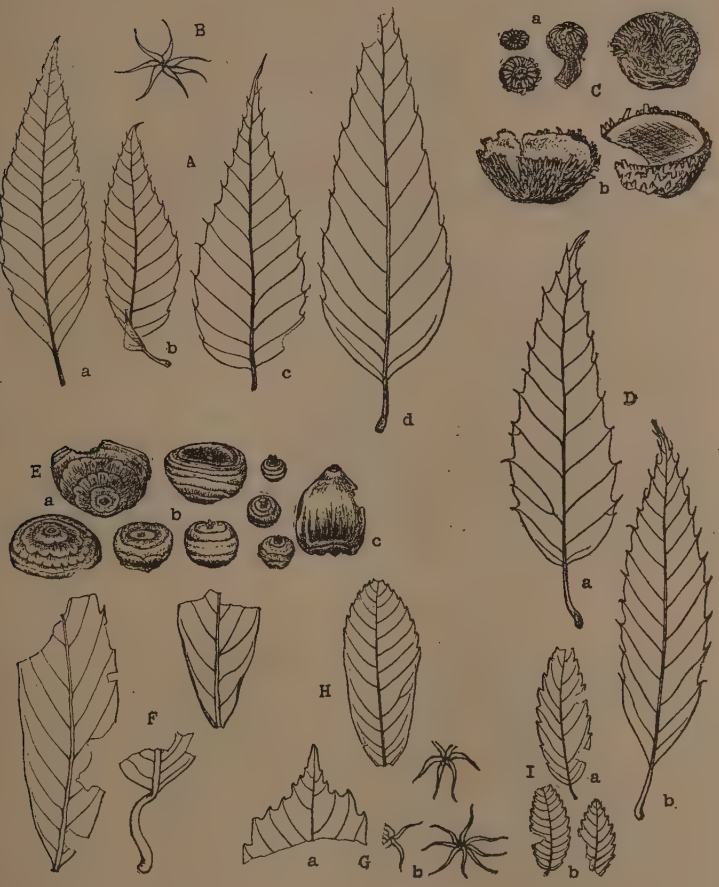

Fig. 12. Fagaceae and Ulmaceae.

A–H *Quercus.*

A–C *Quercus variabilis* Bl. from Inzyo: A leaves $\times\frac{2}{3}$; B tufted hair $\times 333$; C young fruits (*a*) and cupules (*b*) $\times 1$, from Hatagoya and Inyzo.

D Leaves of *Quercus acutissima* Carr. $\times\frac{2}{3}$ from Inzyo.

E–F *Quercus* cf. *stenophylla* Makino.
E Cupules, seed and fruits $\times 1$; F leaves $\times 1$.

G–H Leaves of *Quercus* cf. *gilva* Bl. $\times\frac{2}{3}$ excl. Gb $\times 333$, H from Osusawa, G from Inzyo: *b* tufted hairs from Ga $\times 333$.

I Leaves of ***Zelkova* cf. *Ungeri*** Kovats $\times\frac{2}{3}$. *a* from Inzyo; *b* from Doi in Hitoori, Pref. Hyogo.

Cupule 17 mm wide, 10 mm high, bract somewhat flat, 4 mm long, 1 mm broad.

The remains identified to a form of the living one by tuft-haired leaf and the flat shape of bract on the cupule.

Another locality in Japan: Cliff of Syurakuen in Titagun, Pref. Aiti.

Ulmaceae

30. *Zelkova* cf. *Ungeri* KOVATS (Fig. 12 I)

Zelkova sp. in MIKI (1933) 623, pl. J, fig. 4 A-B.

Zelkova Ungeri KOVATS in MIKI (1937) 312, pl. 9 N-O, fig. 3 D-E; (1938 a) 219, fig. 4 L; 224, fig. 6 B.

Planera Ungeri ETT. in NATHORST (1888) 201, 203, pl. 1 fig. 5–9.

A leaf occurred at Inzyo. Lanceolate leaf, 3.5 cm long, 14 mm broad, mucronate on apex; petiole about 4 mm long.

The remain identified to the genus by slightly asymmetrical position of the midrib and the shape of serration and referred to the species by obtuse serration and narrow lamina with slightly longer petiole than the living *Zelkova keaki* MAKINO.

Further locality in Japan: Lignite Beds of Doi in Hitoori, Pref. Hyogo.

Nymphaeaceae

31. *Brasenia Schreberi* GMEL. (Pl. VII B, Fig. 13 F)

Abundant seeds occurred from Hatagoya, Tamodaira, Obata, Akazu and Hosono, especially rich in Akazu and Hosono. Seed obovate, 3–4 mm long, 3 mm broad, hilum and raphe well marked at the base, testa with minute tuberculation. Epidermis composed of large waved cells.

The remains identified to the genus by the presence of hilum and raphe, and by waved large epidermal cells. The shape and size correspond closely to a form of the living one.

Other localities in Japan: Clay Beds of Sidatani in Simagahara Pref. Mie; Lignite Beds of Kowa and Cliff of Syurakuen in Titagun, Pref. Aiti.

Menispermaceae

32. *Sinomenium acutum* REHD. et WILS. (Fig. 13 H)

Two seed remains occurred from Itirizuka. Seed orbicular-reniform, about 5 mm wide, 4–5 mm broad with crenulate thick margin.

The genus identified by the reniform shape of seed which has crenulate thick margin. The size and shape correspond to a form of the living one.

Fig. 13. Ranales.

A Seeds of *Magnolia obovata* THUNB. ×2: *a–c* from Simoiguta; *d* from Itinokuraguti; *e* from Itinohoro.
B Seeds of *Magnolia kobus DC.* from Sidatani, Pref. Mie ×2.
C Seeds of ***Schizandra megasperma*** n. sp. from Itinohora *a–b* ×2; *c* epidarmis ×333.
D Seeds of *Schizandra nigra* MAX. from Sidatani, Pref. Mie ×2.
E Seed of ***Euryale akasiensis*** MIKI from Arigahukuro in Sanbongi, Pref. Miyagi: *a* ×1, *b* epidermis ×233.
F Seeds of *Brasenia Schreberi* GMEL. *a* ×4, *b* epidermis ×120.
G Seeds of ***Stephania Dielsiana*** WU from Simoiguta ×2.
H Seeds of *Sinomenium acutum* REHD. et WILS. from Itirizuka ×2.
I–K *Benzoin umbellatum* REHD.: I Seeds from Obata ×2.
J–K(?) Leaves ×$\frac{2}{3}$ from Inzyo.

Other localities in Japan: Lignite Beds of Kamitomono in Iga, Pref. Mie; Lignite Beds of Hanataka near Takasaki, Pref. Gunma.

33. *Stephania Dielsiana* WU (Pl. VI C, Fig. 13 G)

Many seeds occurred at Obata, Simoiguta and Itinokuraguti, especially rich in Simoiguta. Seed obovate, 7–8 mm long, 6 mm broad with central pore and horseshoe-like thick margin with 20 characteristic crenulations.

The remain identified to the genus by central pore and horseshoe-shaped thicker margin and to the species by large size and twice many crenulations than *Stephania japonica* MIERS. Living one of the species has been described from Kwansi and Kweichow by WU (1940).

Another locality in Japan: Lignite Beds of Hanataka near Takasaki, Pref. Gunma.

Magnoliaceae

34. *Magnolia obovata* THUNB. (Fig. 13 A)

Magnolia hypoleuca S. *et* Z. in MIKI (1933) 624, pl. C.

Magnolia obovata THUNB. in MIKI (1937) 315, fig. 4 A; (1938 a) 237, fig. 14 Da.

A few seed remains occurred from Inzyo, Itinokuraguti and Itinohora. Seed cordate, about 7–9 mm long, 5–7 mm broad with dorsal striations, hilum small on the ventral side.

The remains identified to the species by indistinct hilum on the ventral and by the dorsal striations.

35. *Schizandra megasperma* n. sp. (Pl. VI G, Fig. 13 C)

Two seed remains occurred at Itinohora. Seed compressed reniform 6–7 mm long, 8 mm broad with crescent hilum; testa with vermiform reticulation, epidermis composed of small polygonal cells.

The remains identified to the genus by reniform shape and by special shaped hilum. The remain is alike to *Schizandra nigra* MAX. by vermiform reticulation of the testa but it differs by large size and different reticulation of the same.

Lauraceae

36. *Benzoin umbellatum* REHD. (Fig. 13 I–K ?)

Remains of seeds and leaves occurred at Obata and Inzyo. Seed elliptic, about 4–5 mm broad, 5 mm long with keel-like basal hilum. Leaf oblong-ovate, 6 cm long, 3 cm broad, entire, caudate, cuneate at the base, behind with long hairs; petiole about 12 mm long.

The seed is referred to the genus by the simple elliptic form and basal hilum and the leaf by prominent lateral veins at the base. It is referred to the species by the shape and hairs on the underside of leaves.

Hamamelidaceae

The remain identified to the family by the capsule and by the well marked crescent hilum on the seed. 3 genera in the beds:

Fruit in a head, seed many in a capsule, leaf 3-lobed.....*Liquidambar*
Fruit in a head or raceme, seed two in a capsule, leaf not lobed
Capsule without pedicel, perianth hypogyne.....*Hamamelis*
Capsule with pedicel, perianth half-superior.....*Fortunearia*

37. *Fortunearia sinensis* Rehd. et Wils. (Pl. VI F, Fig. 14 D)

Abundant seed and capsule occurred at Obata, Inzyo, Itinokuraguti, Simoiguta, Osusawa and Hosono, especially rich in Itinokuraguti and Simoiguta. Seed oblong, lustrous, 10–11 mm long, 5–6 mm broad, hilum deep and large, 4 mm long and 2 mm broad. Capsule pedicellated on the raceme, perianth half-superior.

The remains of capsule were distinguished from *Corylus* and *Hamamelis* by possession of pedicel and by the seed differing from other genus by large marked hilum. The size and shape correspond to the living one which is confined now to central China only.

Other localities in Japan: Clay Beds of Huke in Sennangun, Pref. Osaka; Cliff of Syurakuen in Titagun, Pref. Aiti.

38. *Hamamelis parrotioidea* n. sp. (Fig. 14 E)

Seeds and capsule remains were found at Hatagoya, Tamodaira and Obata, especially rich in Tamodaira. Peduncle about 7 mm long, capsule 4 sessile on the head; perianth hypogynous. Seed fusiform, lustrous, 5–6 mm long, 2–3 mm broad.

The remains identified to the genus by hypogynous and aggregate capsule and recognized as a new species by many capsules on the peduncle and the half size of seeds.

Another locality in Japan: Clay Beds of Okuradani in Akasi, Pref. Hyogo.

39. *Liquidambar formosana* Hance (Pl. VI A–B, Fig. 14 A–C)

Nathorst (1883) 55, pl. 8 fig. 6–9; (1888) 24, pl. 6 fig. 14–15; Florin (1920) 20, pl. 3 fig. 3; 32 pl. 6 fig. 4; Kryshtofovich (1920) 9, pl. 2 fig. 3–4; Konno (1931) pl. 4 fig. 1, pl. 12 fig. 7; Endo and Morita (1932) 47, pl. 6 fig. 1–10, pl. 7 fig. 1–8.

Many remains of fruit and leaf occurred at Inzyo, Itinokuraguti and Simoiguta. Fruit multicapsular, head hemispherical, usually more or

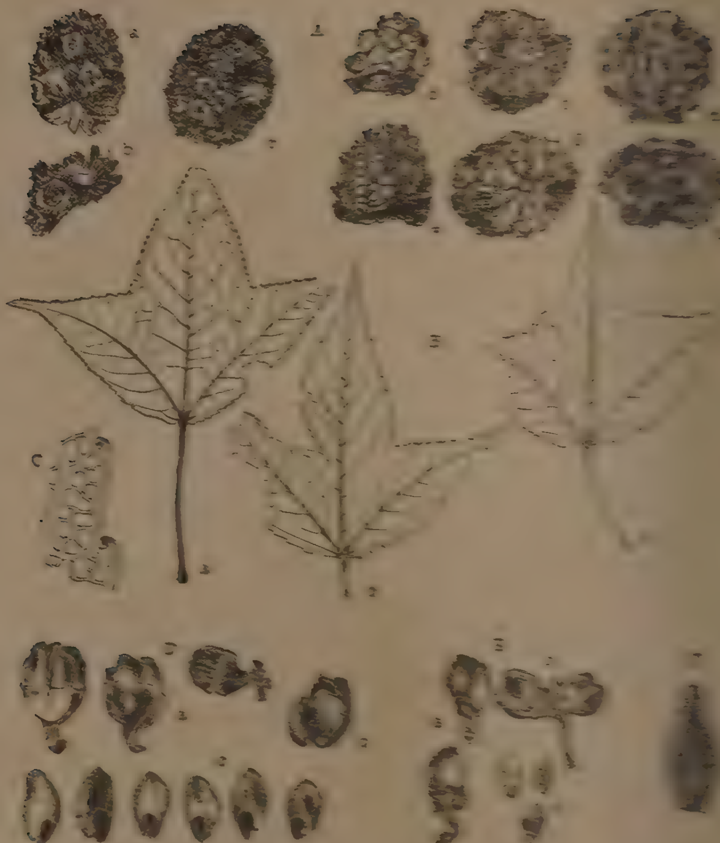

Fig. [illegible]

A–[illegible] Liquidambar formosana [illegible]

A [illegible]

B Leaves from [illegible]

[illegible]

E Hamamelis [illegible]

[illegible]

F [illegible]

ss flat by compression; 1–1.5 cm high, 1.5–2 cm broad. Leaf 3-lobed, ate, incurved, glandulated serration at the margin; petiole 4 cm long ith scar of detached stipule on both sides.

The remain of the fruit seems as that of *Altingia* when it is destitute bristles but it is well identified to the genus by remaining bristles. e character of fruit and leaf correspond to the living ones which grow wild state in central to southern China and Formosa.

Many localities of the remain were known from tuff layer in the rtiary throughout Japan but further localities may be mentioned from beds of Huke in Sennangun, Pref. Osaka; Cliff of Syurakuen in agun, Pref. Aiti; Lignite Beds of Kitomo in Hunagata, Pref. Yamagata.

Eucommiaceae

40. *Eucommia ulmoides* OLIV. (Pl. VI E, Fig. 14 F)

A nearly complete fruit was supplied from Itinohora. Fruit ovate-ong, 6 mm broad, notched at the apex, seed surrounded by fibrous embrane.

Monotypic genus identified easily by peculiar shape of the samara, part of which is composed of transversally directed fibrous structure. size is slightly smaller than the living one existing now in Central a, but it is still a form of the living, as there is none of separable aracter.

The distribution of the genus seems to be wide in the Tertiary, for remains of seed are recorded from the Pliocene and the Pleistocene posits in Europe (REID and REID p. 98 and BAAS p. 334).

Rosaceae

41. *Amelanchier* cf. *asiatica* ENDL. (Fig. 15 A–B)

A few leaves occurred at Inzyo. Leaf oblong obovate to oblanceolate, of 23 mm broad, 5 cm long, slightly cordate or cuneate at the base fine serrations. Petiole terete with pulvinus-like swelling at the se, about 1 cm long.

The remain identified to the genus by the terete petiole and referred the species by the size and shape of leaves.

Leguminosae

The remains identified to the family by the existence of pods, leaves pulvinus and branched spines. 3 genera were found in the beds.

With branched thorn. ..... *Gleditschia*
Without branched thorn
Elliptic leaf with emerginate top..... *Dalbergia*
Ovate leaf with caudate top ..... *Wistaria*

Fig. 15. Rosaceae and Leguminosae.

A–B Leaves of *Amelanchier* cf. *asiatica* ENDL. from Inzyo.
A $\times\frac{2}{3}$, B $\times 10$.

C–D ***Wistaria ligniata*** n. sp. from Inzyo.
C leaves $\times\frac{2}{3}$, D Pods $\times\frac{2}{3}$.

E–F ***Gleditschia*** cf. ***macracantha*** DESF. from Inzyo.
E Spines $\times\frac{2}{3}$, F Pod $\times\frac{2}{3}$.

G Leaf of ***Dalbergia*** sp. from Inzyo: *a* $\times\frac{2}{3}$, *b* $\times 10$.

42. *Dalbergia* sp. (Fig. 15 G)

A remain of leaf occurred at Inzyo. Leaf elliptic, notched at the apex, 2 cm long, 10 mm broad, glabrous with 6 pairs of lateral vein, pulvinus 2 mm long.

The remain seems like a leaflet of *Lespedeza* but it differs by elliptic form and glabrous appearance and reduced to the genus by its shape, though the further identification is impossible.

The living one is distributed in China and North America.

43. *Gleditschia* cf. *macracantha* DESF. (Fig. 15 E–F)

Characteristic huge spines and fragmental pods occurred at Inzyo. Branched spine 17 cm long, 7 mm broad, basal spine up to 8 cm long; pod 3.5 cm broad.

Huge spines of living ones are recorded from various localities: *Gleditschia macracantha* DESF. from China, *G. caspica* DESF. from Persia and *G. triacanthos* L. from North America (DIPPEL p. 655). The remain is referred provisionally to *G. macracantha*, but without other parts the sufficient identification is impossible.

44. *Wistaria ligniata* n. sp. (Fig. 15 C–D)

Abundant leaves and a few pods were found from Inzyo. Leaf ovate, 4–7 cm long, 2–3.5 cm broad, glabrous, caudate, with about 9 pairs of lateral vein; pulvinus 4 mm long; pod 2 cm broad.

The remain of leaf seems like a pinnate leaflet of *Cladrastis*, *Maackia* or *Wistaria*, but it differs from *Cladrastis* by a few indistinct lateral veins and from *Maackia* by caudate glabrous leaf. The shape of pod and leaf corresponds to that of *Wistaria* but it differs by the large size and thicky appearence of leaf.

Rutaceae

45. *Fagara ailanthoides* ENGL. (Fig. 16 E)

MIKI (1937) 318, fig. 7 C.

A seed occurred at Simoiguta. Seed semiovate, about 3.3 mm long, 3 mm broad, ventral side with long grooved hilum. Testa reticulate by coarse areolation.

The shape and size closely correspond to the living one.

Euphorbiaceae

46. *Mallotus protojaponicus* n. sp. (Pl. VI H, Fig. 16 A–C)

Many leaves and seeds occurred from Hatagoya and Inzyo. Leaf ovate, entire, caudate, base cuneate or round, palmatinerved, 6–7 cm long,

Fig. 16.

A–C ***Mallotus protojaponicus*** n. sp, from Inzyo.
A Leaves ×⅔. B Hairs on the underside ×50. C Seeds ×4.

D Leaves of *Buxus japonica* MUELL. ×1. *a–b* from Kamitomono, Pref. Mie; *c* from Itinohora.

E Seed of *Fagara ailanthoides* ENGL. from Simoiguta ×4.

F Seeds of *Fagara mantchurica* HONDA from Sidatani, Pref. Mie ×4.

G Fruits of ***Tripterygium multipterium*** n. sp. from Itinokuraguti ×1.

H–I Seeds of *Euscaphis japonica* PAX. from Itinokuraguti, H ×2; I epidermis ×50.

J Endocarps of *Spondias axillaris* ROXB. ×1.
a–b var. ***polymeris*** nov.
f–i var. ***stenocarpa*** nov. .
a and *f* from Osusawa; *b* from Hatagoya; *c* from Simoiguta; *d–e* from Inzyo; *g–i* from Itinokuraguti.

3–3.5 cm broad, underside with simple and stellate hairs; petiole with pulvinus-like swelling at both ends, about 1.5–2 cm long. Seed elliptic, 4 mm long, 3–3.5 mm broad, base rounded, mucronate at the apex; testa distinctly tuberculated.

The remain identified to the genus by palmated nervation, marked horizontal connection of veinlets and heteromorphic hairs. The seed identified by the shape and tuberculated testa. The shape of leaves resembles that of *Mallotus philippinensis* MUELL., though it differs by the coexistence of simple hairs.

Another locality in Japan: Lignite Beds of Hanataka near Takasaki, Pref. Gunma.

Buxaceae

47. ***Buxus japonica*** **MUELL** (Fig. 16 D)

MIKI (1937) 320, fig. 7 A–B.

Many leaves were found from Itinohora. Leaf identified to the genus by the shape and well developed cuticle.

The size and shape of leaves correspond to the living one.

Further localities in Japan: Lignite Beds of Doi in Hitoori, Pref. Hyogo; Clay Beds of Oisendo in Hukakusa, Pref. Kyoto and Lignite Beds of Kamitomono in Ayamagun, Iga, Pref. Mie; Clay Beds of Kowa, Titagun, Pref. Aiti.

Anacardiaceae

Spondias (Pl. VI I, Fig. 16 J)

Stony endocarp remains occurred from Hatagoya, Tamodaira, Inzyo, Itinokuraguti and Osusawa. The remain identified to the genus by woody endocarp with several germ pores at one end. The genus has 3 species confined now to Eastern Asia. Living species in Japan occurs at Hukuregi in Amakusa, Kyusyu Island but the cultivated one may be wintered easily at Kyoto.

48. ***Spondias axillaris*** **ROXB.** (Pl. VI Ib, Fig. 16 J c–e)

A few fruits occurred in Hatagoya, Tamodaira and Inzyo. Fruit obovoid, about 16 mm long, 12 mm wide, top round with five germ pores near the apex and five small pits at the mucronate base.

This identified to the species by its shape and size. Living species in Japan occurs now in Kyusyu only.

Another locality in Japan: Clay Beds of Yamanakasinke in Higasitotorimura, Sennangun, Pref. Osaka.

var. *polymeris* nov. (Pl. VI Ia, Fig. 16 J a–b)

Three fruits occurred at Hatagoya and Osusawa. The remain elliptic or obovate, 20 mm long, 15–20 mm broad, slightly concurved at the base.

The remain differs from typical one by a large number of carpels (6–7) and by the concurved base.

Another locality in Japan: Clay Beds of Sidatani in Simagahara, Pref. Mie.

var. *stenocarpa* nov. (Pl. VI Ic, Fig. 16 J f–i)

Many endocarp remains occurred at Hatagoya, Inzyo and Itinokuraguti. Fruit obovoid, 16–20 mm long, 8–12 mm broad, top round, acute at the base; germ pores 5.

The remain differs from typical one by the narrow and acute base.

Celastraceae

49. ***Tripterygium multipterium* n. sp.** (Pl. VII A, Fig. 16 G)

Abundant fruits found at Inzyo and Itinokuraguti. Fruit oblong with sepal and pedicel, about 20 mm long, 8–14 mm broad, the upper half with 10 wing-like striations. Carpel 3 as suggested from triparted apex.

The remain identified to the genus by the hypogynous perianth and three carpels but it differs from the living one by many wings. At a glance the remain seems like *Meliodendron,* but differs by superior ovary.

Staphyleaceae

50. ***Euscaphis japonica* PAX.** (Fig. 16 H–I)

Many seeds occurred from Inzyo, Itinokuraguti and Simoiguta. Seed obovate, hilum distinctly grooved, testa woody, thick, rugose by marked tuberculation.

The seeds identified to the genus by woody testa with large hilum and by special tuberculation. The remain closely corresponds to the living one by the shape and size.

Other localities in Japan: Clay Beds of Yamanakasinke in Higasitotorimura, Sennangun, Pref. Osaka; Clay Beds of Sayado in Masiko, Pref. Totigi.

Aceraceae

The fruits and leaves were found sporadically in the beds. The genus identified by a special form of the fruit and palmately veined leaf. 2 species were found in the beds.

51. *Acer palmatum* THUNB. (Fig. 17 B–Cd)

Leaves and a fruit occurred from Hatagoya, Inzyo and Simoiguta. The leaf identified to the species by 7 palmate nerves and by fine serrated acuminate lobes and the fruit by the splitting surface rectangular to the seed and parallel striations.

52. *Acer rubrum* L. var. *ligniatum* nov. (Fig. 17 A)

Many leaves were found from Inzyo and Osusawa. Leaf cordate, 3-lobed by acute sinuses, lobes with irregular double serrations with obtuse incurved top, the underside with scattered long hairs.

The leaf identified to the species by 3 palmate nerves and obtuse incurved serration but it differs from typical one by long hairs on the underside.

Sabiaceae

Remains of seed were found sporadically in the beds. The seed identified to the family by reniform and grooved oblique hilum at the ventral side and by marked areolation of testa. 2 genera in the beds.

Seed not compressed.....*Meliosma*
Seed compressed.....*Sabia*

53. *Meliosma* cf. *rigida* S. et Z. (Fig. 17 H)

Seed remains occurred at Hatagoya, Itirizuka and Simoiguta. Seed obovate, about 4 mm high, 4–5 mm broad, keeled; lateral surface with coarse areolation.

Many living species occur in Asia but the remains were identified to the species by the size and areolation of seed.

Other localities in Japan: Clay Beds of Huke, Pref. Osaka; Clay Beds of Sidatani in Simagahara, Pref. Mie.

54. *Sabia japonica* MAX. (Fig. 17 D–E)

Many seeds and a few leaves occurred at Inzyo, Itinokuraguti, Simoiguta and Itinohora. Seed reniform, 5–6 mm high, 6–7 mm broad, hilum obliquely grooved, lateral side with parenchymatous reticulation. Leaf oblong-elliptic, slightly undulate at the margin, 4–6 cm long, 2–2.5 cm broad, slightly oblique at the base with notch-like constriction near the base, petiole about 1 cm long and branching of the veinlet with botryoid appearance.

The remain identified to the genus by the size of seed, the notch-like constriction and botryoid veinlet in lamina. The size and shape of lamina correspond closely to the living one.

Fig. 17. Sapindales and Rhamnales.

A Leaves of *Acer rubrum* L. var. ***ligniatum*** nov. from Osusawa excl. *f* from Inzyo. *b* Margin of *a* ×4. *g* hairs of underside ×50. *a* and *c–f* ×$\frac{2}{3}$.

B–Cd *Acer palmatum* THUNB. B×$\frac{2}{3}$. *a* from Inzyo, *b* from Osusawa.

C Samaras of *Acer* sp. ×1. *a* from Hatagoya, *b–c* from Osusawa, *d* from Inzyo.

D–E *Sabia japonica* MAX. D Seeds ×2: *a* from Simoiguta, *b* from Inzyo, *c* from Osusawa. E Leaves from Inzyo: *a–c* ×$\frac{2}{3}$, *d* nerve ×10.

F Endocarps of *Berchema racemosa* S. et Z. ×2. *a* from Hatagoya, *b* from Sidatani, Pref. Mie.

G ***Paliurus*** cf. ***nipponicus*** MIKI ×1. *a* Fruits from Inzyo, *b–c* twigs and spine, from Inzyo (*b*) and Hatagoya (*c*).

H Seeds of *Meliosma* cf. *rigida* S. et Z. from Hatagoya ×2.

I Seeds of *Vitis* cf. *Thunbergii* S. et Z. ×2. *a–b* from Hatagoya, *c* from Osusawa *d* from Sidatani, Pref. Mie.

J Seeds of *Cissus japonica* WILLD from Itinohara ×4.

K Seeds of ***Cissus megasperma*** n. sp. ×2. *a* from Osusawa, *b* from Hatagoya, *c–e* from Itirizuka.

Other localities in Japan: Cliff of Asiyagawa, Pref. Hyogo; Clay Beds of Huke in Sennangun, Pref. Osaka; Chiff of Simosibutani in Ikeda, Pref. Osaka; Clay Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Tokonabe in Titagun, Pref. Aiti.

Rhamnaceae

Two genera were found in the beds but very rare.

Carpel two, without corky exocarp.....*Berchemia*
Carpel three, with corky exocarp.....*Paliurus*

55. *Berchemia racemosa* S. et Z. (Fig. 17 F)

Ternstroemia japonica THUNB. in MIKI (1933) 625, pl. D, fig. 4 N–O.
Berchemia racemosa S. et Z. in MIKI (1937) 322, fig. 8 F–H; (1938 a) 237, fig. 14 L.

An endocarp remain occurred at Hatagoya. It is oblong, 7 mm long, 4 mm broad, top round, basal part broken by germ pores.

The remain identified to the species by the sutural line and by eroded base. The genus is now confined to Asia but the remains are recorded from the northern hemisphere in the Tertiary (KRÄUSEL p. 78).

Further localities in Japan: Lignite Beds of Sanzi in Moriyama, Oegun, Pref. Tokusima; Lignite Beds of Doi in Hitoori, Pref. Hyogo; Clay Beds of Huke in Sennangun, Pref. Osaka; Clay Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Kowa and Tokonabe in Titagun, Pref. Aiti.

56. *Paliurus* cf. *nipponicus* MIKI (Fig. 17 G)

MIKI (1933) 624, pl. Q–U, fig. 2 F–J; (1937) 324, pl. 9 H–I, fig. 8 A–E; (1938 a) 216, fig. 2 A; 220, fig. 5 E; 224, fig. 6 A.

Fruits and branches occurred from Hatagoya, Obata and Inzyo. Fruit 8–13 mm broad, encircled by expanded wing, carpel 3. Branch with heteromorphic stipular spine at the node.

The remain identified to the genus by stipular heteromorphic spine and 3 carpels surrounded by coronary expanded wing.

Further localities in Japan: Clay Beds of Sidatani in Simagahara, Pref. Mie; Clay Beds of Huke in Sennangun, Pref Osaka.

Vitaceae

Seed remains were found sporadically in the beds. The remain identified to the family by long narrow groove in the ventral facet and by the dorsal pattern.

57. *Cissus japonica* WILLD (Fig. 17 J)

A few seeds occurred at Simoiguta and Itinohora. Seed roundly ovate, ventral side slightly concave, distinctly wrinkled, beak short.

The shape and size correspond to the living one.

58. *Cissus megasperma* n. sp. (Pl. VII C, Fig. 17 K)

A few seeds occurred from Hatagoya, Tamodaira, Inzyo, Itirizuka and Osusawa. Seed fusiform, 7–9 mm long, 4–5 mm broad, beak not prominent, transversally wrinkled at the dorsal side, long narrow groove at the ventral surface as usual in the family.

The remain identified to the genus by the transversally wrinkled and not prominent beak and its double size compared with the living one.

59. *Vitis* cf. *Thunbergii* S. et Z. (Fig. 17 I)

Seed remains occurred at Hatagoya, Simoiguta and Osusawa. Seed ovate, 4–5 mm long, 3.5–4 mm broad, beak short.

The remain identified to a form of the living one by its shape and size.

Tiliaceae

In the beds at Inzyo there occurred leaves and bracts, belonging to the genus *Tilia*. The remain identified to the genus by palmatinervous leaf and the bract subtending the inflorescence. 2 species in the beds.

60. *Tilia kiusiana* MAKINO et SHIRASAWA (Fig. 18 A)

A few leaves occurred at Inzyo. Leaf ovate, 3–7 cm long, 2.5–4 cm broad, abruptly acuminate at the apex, obliquely truncate at the base, teeth slightly glandular, petiole short, about 1.4 cm long.

The remain identified to the species by small size, obliquely truncated base and short petiole. Living one is confined now to Northern Kyusyu.

61. *Tilia japonica* SIMK. (Fig. 18 B–C)

Tilia cf. *cordata* NATHORST (1888) 34, pl. 10, fig. 11.

Tilia japonica SIMK. in MIKI (1938 a) 229, pl. 4 H, fig. 10 K; ENDO (1940) 68, pl. 4 fig. 1; pl. 8 fig. 7, 19; KOIDZUMI (1940) 21, fig. 26, 76, 88.

Leaves and bracts were found in Inzyo. Leaf ovate, 5–6 cm long, 3.5–4 cm broad, acuminate, obliquely cordate at the base, petiole about 2.2–2.5 cm long. Bract 1.1–1.3 cm broad, obliquely cuneate at the base; petiole about 2 cm long.

Fig. 18. Tiliaceae and Theaceae.

A Leaves of *Tilia kiusiana* MAKINO et SHIRASAWA. ×⅔, from Inzyo.
B–C *Tilia japonica* SIMK. from Inzyo ×⅔. B leaf, C bracts.
D *Camellia japonica* L. from Inzyo ×1. *a–b* fruits, *c* seed.
F Fruits of *Stewartia pseudocamellia* MAX. ×1. *a* from Masiko, Pref. Totigi, *b* from Itinokuraguti, *c* from Inzyo.
E,G *Stewartia monadelpha* S. et Z. E Leaf from Inzyo ×⅔. G Fruits ×1. *a–b* from Masiko, Pref. Totigi, *c* from Itinokuraguti, *d–e* from Simoiguta.

The remain identified to the species by the cordated base and long petiole of both the leaf and bract. Living species is widely distributed in the temperate region of Japan.

Theaceae

The remain identified to the family by loculicidal capsule and hypogynous perianth. 2 genera in the beds.

Capsule 3-celled without or with short peduncle, seed wingless.....*Camellia*
Capsule 5-celled, pedunculate, seed winged.....*Stewartia*

62. *Camellia japonica* L. (Fig. 18 D)

MIKI (1938 a) 220, fig. 5 K.

Two fruits and two seeds occurred at Inzyo. Fruit obovate, 3 cm long, 12 mm broad, with triparted apex; axis with scars of perianth. Seed elliptic, 17 mm long, 13 mm broad, hilum marked at one end.

The remain identified to the genus by the loculicidal capsule and many perianth scars on the axial part and the seed referred to the species by the size and shape of the hilum.

Stewartia (*Stuartia*)

Abundant 5-angled woody capsules occur everywhere in the beds and a leaf was found at Inzyo. The genus confined now to Asia and America but the distribution in the Tertiary seems to be wide, as the capsules occur also in Europe (REID and REID p. 118). 2 species in the beds.

63. *Stewartia monadelpha* S. et Z. (Fig. 18 E,G)

Stuartia monadelpha S. et Z. in MIKI (1937) 324, fig. 8 K; (1938 a) 224, fig. 6 K.

Many capsules occurred at Inzyo, Itinokuraguti and Simoiguta. Capsule ovate, splitting to 5-woody valves; each piece about 12 mm long, 4–5 mm broad, peduncle about 1–1.5 cm long. Leaf oblong-ovate, about 20 mm broad, acute at the top.

The character of the remains correspond closely to the living one, growing now in the Southern Honsyu at about 1000 m altitude.

Further localities in Japan: Clay Beds of Huke and Tutimaru in Sennangun, Pref. Osaka; Clay Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Kowa and Tokonabe in Titagun, Pref. Aiti; Clay Beds of Sayado in Masiko, Pref. Totigi.

64. ***Stewartia pseudocamellia*** MAX. (Fig. 18 F)

Stuartia pseudocamellia MAX. in MIKI (1937) 324, fig. 8 I–J; ENDO (1940) 69, pl. 10, fig. 4, 14.

A few capsules occurred at Inzyo, Itinokuraguti and Simoiguta. Capsule identified to the species by the large size and thick and short peduncle compared with the former.

The living species distributes in the temperate region of Japan. Further localities in Japan: Clay Beds of Sidatani in Simagahara, Pref. Mie; Clay Beds of Sayado in Masiko, Pref. Totigi.

Hydrocaryaceae

Two genera in the beds, one of which represents a new genus and new species.

Ovary inferior, fruit with different leveled decussate horne, without peduncle. ..... *Trapa*

Ovary half-inferior, fruit without decussate horn, with peduncle..... *Hemitrapa*

65. ***Hemitrapa trapelloidea*** **n. g. n. sp.** (Pl. VII D, Fig. 19 D)

Abundant fruit remains occurred at Hatagoya, Obata, Akazu, Inzyo and Osusawa, especially rich in Hatagoya and Akazu. Fruit fusiform, falcate, about 6–9 mm broad, 20 mm long including the peduncle. Receptacle half-superior, upper margin with 2 long antenna-like appendages with reflexed barb at the apex and 4–5 small spine-like appendages between them. Protruding fibrous part about 5 mm long; peduncle about 4 mm long.

The remain identified to the Hydrocariaceae by one-celled fruit with persistent sepal and protruding apex. It differs from *Trapa* by the absence of distinct horn at different level and by the existence of the persistent peduncle. It has more allied characters with Onagraceae by the position of the undifferentiated perianth and by the existence of persistent peduncle; therefore the remain is identified to a new genus. The antenna-like appendages of the fruit seem somewhat alike to those of *Trapella*, so the remain has been named *Hemitrapa trapelloidea*. The falcate shape of fruit remain may be considered as its ripe stage, in which it bends downward as in many water plants.

66. ***Trapa incisa*** **S. et Z.** (Fig. 19 C)

MIKI (1937) 325, fig. 9 B; (1938 a) 225, fig. 7 A; (1938 b) 413, fig. 1 O.

A few fruit remains occurred at Itinokuraguti and Hosono. It is about 9 mm high, 8 mm broad with four horns; upper horn obliquely ascendent, short horn curved toward the base.

Fig. 19. Hydrocaryaceae, *Nyssa* and *Cornus*.

A–B ***Trapa mammillifera*** MIKI ×1. A from Hatagoya, B from Sidatani, Pref. Mie.

C *Trapa incisa* S. et Z. ×1. *a* from Hosono, *b* from Itinokuraguti, *c* from Sidatani, Pref. Mie.

D ***Hemitrapa trapelloidea*** n. g. n. sp. ×1. *a–c* from Akazu, *e–d* from Hatagoya.

E ***Nyssa pachycarpa*** n. sp. from Itinokuraguti. ×1. *a* cross-section.

F ***Nyssa sylvatica*** MARSH. from Inzyo ×1. *a* cross-section.

G Leaf of ***Nyssa*** ? from Inzyo. *a* ×$\frac{2}{3}$, *b* ×100

H Fruits of *Cornus controversa* HEMSL. ×2. *a–b* from Osusawa, *c–d* from Sidatani, Pref. Mie.

The remain identified to the species by the size and shape of the fruit.

Other localities in Japan: Lignite Beds of Doi in Hitoori, Pref. Hyogo; Cliff Asiyagawa, Pref. Hyogo; Clay Beds of Sagawa near Kasagi, Pref Nara; Clay Beds of Sidatani in Simagahara, Pref. Mie; Clay Beds of Nisikureha near Toyama, Pref. Toyama.

67. *Trapa mammillifera* MIKI (Pl. VII E, Fig. 19 A–B)

MIKI (1938 b) 413, fig. 1 M–N.

Abundant fruits occurred at Hatagoya, Obata, Itirizuka and Inzyo. Fruit about 3 cm broad, 12 mm high; the horizontally directed upper horn with basal protuberance at each side, the lower horn short and curved toward the base.

The remain identified to the species by the basal protuberances on both sides of the upper horns.

Other localities in Japan: Clay Beds of Sidatani in Simagahara; Cliff of Kyusenro in Narasaka, Pref. Nara; Clay Beds of Sagawa near Kasagi, Pref. Nara.

Nyssaceae

Abundant endocarp remains belonging to *Nyssa* occurred in the beds. The remain identified to the genus by longitudinal arrangement of endocarp cells and special mark of germ shutter at one side.

The genus occurs now in North America and Central China but the remain is recorded from the Tertiary in Europe (REID and REID p. 121, KIRCHHEIMER 1939, p. 275). 2 species in the beds.

68. *Nyssa sylvatica* MARSH (Pl. VII Kb, Fig. 19 F)

Abundant seed remains occurred from Hatagoya,Tamodaira, Obata, Inzyo, Itinokuraguti, Simoiguta, Osusawa and Itinohora, especially rich in Inzyo. Seed elliptic, 10–14 mm long, 5–7 mm broad, one-celled with about 10 striations, thickness of the carpel wall about 0.7 mm. Germ shutter at one end of the ventral side.

The size and shape correspond to living one which occurs now in North America.

Widely distributed in the clay or lignite beds throughout Japan: Clay Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Kaikake, Pref. Siga; Lignite Beds of Tokonabe, Titagun, Pref. Aiti; Lignite Beds of Hanataka near Takasaki, Pref. Gunma; Lignite Beds of Koike in Kasima-tyo, Pref. Hukusima; Lignite Beds of Kongosawa in Sendai and Lignite Beds of Arigahukuro in Sanbongi, Pref. Miyagi; Lignite Beds of Kitomo in Hunagata, Pref. Yamagata.

69. *Nyssa pachycarpa* n. sp. (Pl. VII K a, Fig. 19 E)

Abundant fruit remains occurred at Obata and Itinokuraguti, especially rich in the latter. Fruit elliptic, 15–20 mm long, 12–14 mm broad, 2-celled, the thickness of woody carpel wall up to about 3 mm.

The remain differs from *Nyssa sinensis* OLIVER by the large size and thicker wall of carpel and from *Nyssa Ogeche* MARSH. by the absence of wing-like striations. The size of fruit is nearly equal to that of *Nyssa disseminata* (LUDWIG) KIRCHHEIMER but differs from it by its elliptic shape.

Cornaceae

70. *Cornus controversa* HEMSL. (Fig. 19 H)

MIKI (1938 a) 234, fig. 12 Q; 238 fig. 14 G a.

A few endocarp remains occurred at Osusawa. It is ovate, about 4 mm broad, 3 mm high, 2-celled, with prominent irregular ribs and a marked hilum at one end.

Living one is confined now to Eastern Asia but in the Tertiary in Europe also (REID and REID p. 126). Further localities in Japan: Lignite Beds of Sanzi in Moriyama, Pref. Tokusima; Clay Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Hanataka near Takasaki, Pref. Gunma; Clay Beds of Sayado in Masiko, Pref. Totigi.

Symplocaceae

Many endocarp remains occurred sporadically in the beds. The remain identified to the genus by endocarp with grooved germ pore at the truncate end. The genus is living now in Eastern Asia, a species also in Eastern America, and the remains from lignite beds also in European Tertiary. 3 species in the beds.

Carpel one, ovoid
- Striation vertical. ..... *Symplocos lancifolia*
- Striation irregular. ..... *Symplocos myrtacea*

Carpel three, elliptic. ..... *Symplocos tricarpa* n. sp.

71. *Symplocos lancifolia* S. et Z. (Fig. 20 J)

One endocarp remain was found from Osusawa. The remain ovate, 3 mm broad, 3 mm high, ribbed with many striations, truncated end with grooved germ pore.

The remain identified to the species by the size and shape. The species restricted now to southern Japan.

Another locality in Japan: Clay Beds of Tutimaru in Sennangun, Pref. Osaka.

72. ***Symplocos myrtacea* S. et Z.** (Pl. VII I, Fig. 20 I)

Abundant endocarp remains were found from Hatagoya, Obata, Akazu, Itirizuka, Simoiguta and Osusawa. Endocarp oblong-ovate, 5 mm long, 3–4 mm broad, one-celled, surface with special reticulation.

The size and structure of the remain correspond to the living one.

Another locality in Japan: Clay Beds of Huke in Sennangun, Pref. Osaka.

73. ***Symplocos tricarpa* n. sp.** (Pl. VII J, Fig. 20 H)

A few endocarp remains occurred at Hatagoya and Simoiguta. Fruit elliptic 5–6 mm long, 4–5 mm broad, 3-celled, surface with indistinct irregular striations.

Three carpellary *Symplocos* are distributed in Asia but 3 different fossil species were recorded in European Tertiary (KIRCHHEIMER 1939 b, p. 282). The remain resembles *Symplocos pseudogregaria* KINK. in European Tertiary but it differs by smaller elliptic shape. It differs also from living species in Japan, *Symplocos lucida* S. et Z. by the half size of the endocarp.

Other localities in Japan: Lignite Beds of Huke and Tutimaru in Sennangun, Pref. Osaka.

Styracaceae

Many fruits and leaves belonging to 2 genera were found in the beds.

Ovary superior, fruit with irregularly dehiscent pericarp. .....*Styrax*
Ovary inferior, fruit indehiscent, capsular drupe.....*Meliodendron*

74. ***Meliodendron nipponicum* n. sp.** (Pl. VII L, Fig. 20 F)

Many fruits occurred from Inzyo. Fruit elliptic, 2–3 cm long, 10–17 mm broad, irregularly ribbed, enclosed in the receptacle except 5–7 mm upper part. Pedicel jointed to fruit, about 15 mm long.

The remain identified to the genus by inferior ovary and woody indehiscent capsular drupe with irregularly ribs, and the genus differs from *Pterostyrax* by jointed pedicel. The remain is akin to *Meliodendron Wangianum* HU but it differs by longer and distinct ribs on the fruit.

Styrax

Abundant seeds, a few fruits and some leaves were found in the beds. The remain identified to the genus by the fruit subtended with persistent calyx, seed with raphe and hilum and testa with small polygonal cells. The leaf identified to the genus by its characteristic shape and the stellate hairs on the underside. In the beds with 4 species.

Seed obovate without 3-ridge between 3-pericarp constrictions
  Seed large, testa smooth.....*Styrax laevigata* n. sp.
  Seed small, testa tuberculate.....*Styrax rugosa* n. sp.
Seed ovate or subglobose with 3-ridge between 3-pericarp constrictions
  Seed subglobose. .....*Styrax Shiraiana*
  Seed ovate or oblong-ovate with distinct raphe.....*Styrax Obassia*

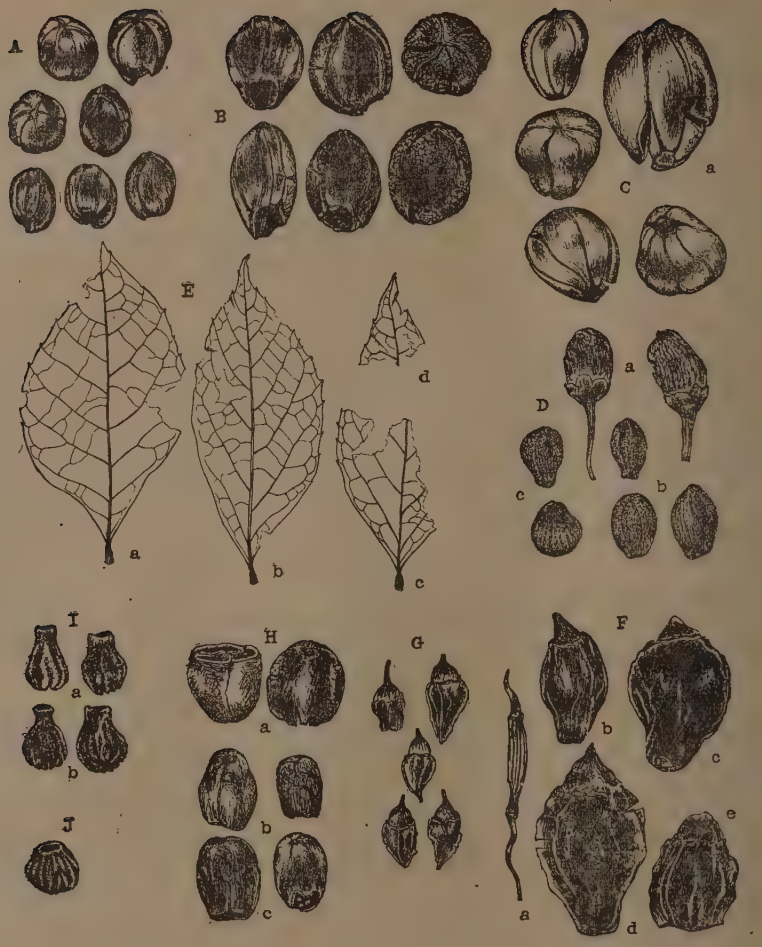

Fig. 20. Styracaceae and Symplocaceae.

A–E *Styrax*.

A Seeds of *Styrax Shiraiana* MAKINO from Simoiguta ×1.

B Seeds of *Styrax Obassia* S. et Z. from Shimoiguta ×1.

C Seeds of ***Styrax laevigata*** n. sp. from Itinokuraguti excl. *a* from Osusawa ×1.

D Seeds of ***Styrax rugosa*** n. sp. ×1. *a* Fruit from Osusawa; *b–c* seed: *b* from Osusawa; *c* from Itinohora.

E Leaves of ***Styrax*** cf. ***rugosa*** n. sp. from Inzyo ×$\frac{2}{3}$.

F Fruits of ***Meliodendron nipponicum*** n. sp. from Inzyo ×1. *a* Young fruit?

G Fruits of *Pterostyrax corymbosum* S. et Z. from Sidatani, Pref, Mie ×1.

H Fruits of ***Symplocos tricarpa*** n. sp. ×2. *a* Hatagoya; *b–c* from Huke, Pref. Osaka.

I Fruits of *Symplocos myrtacea* S. et Z. ×2. *a* from Itirizuka, *b* from Hatagoya.

J Fruit of *Symplocos lancifolia* S. et Z. from Osusawa ×2.

75. ***Styrax laevigata* n. sp.** (Pl. VII G, Fig. 20 C)

A few seed remains occurred at Obata, Itinokuraguti and Osusawa. Seed obovoid, 14–22 mm long, 9–19 mm broad, testa smooth, hilum small.

The remain identified to be a new species by lustrous large obovate seed and small hilum.

76. ***Styrax Obassia* S. et Z.** (Pl. VII Hb, Fig. 20 B)

MIKI (1937) 327, fig. 9 L–M; (1938 a) 216, fig. 2 L; 225 fig. 6 O; 234, fig. 12 U; 238, fig. 14 Tb.

Abundant seed remains occurred from Simoiguta and Itinohora. Seed ovate or oblong ovate 13–15 mm long, 10–12 mm broad, with marked raphe and large hilum.

The remain identified to a form of the living one, because there is no essentially separable character.

77. ***Styrax rugosa* n. sp.** (Pl. VII Ha, Fig. 20 D–E)

Abundant remains of seed occurred at Hatagoya, Tamodaira, Obata, Itirizuka, Inzyo, Itinokuraguti, Simoiguta and Osusawa, especially rich in Itinokuraguti. Seed obovate, 9–11 mm long, 6–8 mm broad, testa with marked tuberculations.

The size is nearly similar to *Styrax japonicum* S. et Z. but it differs by obovate shape and tuberculated testa.

Other localities in Japan: Lignite Beds of Sidatani in Simagahara, Pref. Mie; Lignite Beds of Hanataka near Takasaki, Pref. Gunma; Clay Beds of Sayado in Masiko, Pref. Totigi.

78. ***Styrax Shiraiana* MAKINO** (Pl. VII Hc, Fig. 20 A)

MIKI (1937) 327, fig. 9 K.

Abundant seed remains occurred at Simoiguta, Itinohora and Hosono. Seed subglobose, 9–10 mm long, 8 mm broad, 3–ridges alternate with 3 pericarp constrictions at the apex.

The remain identified to the species by the size and distinct ridge at the apex.

Oleaceae

79. ***Fraxinus* cf. *japonica* BL.** (Fig. 21 C)

Two fruit remains belonging to *Fraxinus* have been obtained from Inzyo. Fruit oblanceolate, about 25 mm long, 3 mm broad with short pedicel.

The remain identified to the genus by the wing at one end and referred to the species by the size and shape.

Fig. 21. Sympetalae and Monocotyledoneae.

A Leaves of *Syringa* cf. *amurensis* RUPR. from Inzyo ×$\frac{2}{3}$.
B Fruits of *Trapella antennifer* GLÜCK from Hatagoya ×1.
C Fruits of *Fraxinus* cf. *japonica* BL. from Inzyo ×1.
D Seeds of *Viburnum Awabuki* K. KOCH from Hanataka, Pref. Gunma ×2.
E Seeds of *Viburnum japonicum* SPRENG. from Simoiguta ×2.
F Fruits of *Rhododendron* ? from Obata ×1.
G Capsels of *Pieris* cf. *japonica* DON from Sidatani, Pref. Mie ×2.
H–I *Phyllostachys* sp. from Inzyo: H Halm ×$\frac{2}{3}$, I leaves ×1.

80. *Syringa* cf. *amurensis* RUPR. (Fig. 21 A)

A few leaf remains occurred in Inzyo. Leaf ovate, 5–6 cm long, 3–4.5 cm broad, apex acute, round or cuneate at the base; petiole about 1 cm long.

The remain identified to the genus by ovate entire leaves with the characteristic venation and to the species by the size and shape.

Pedaliaceae

81. *Trapella antennifer* GLÜCK (Pl. VII F, Fig. 21 B)

Trapella sinensis OLIV. in MIKI (1938 a) 225, fig. 7 E; 238 fig. 14 U.

Abundant fruit remains occurred at Hatagoya, Obata, Itirizuka, Inzyo and Itinokuraguti, especially rich in Hatagoya and Itirizuka. Fruit oblanceolate, about, 1 cm long, 2 mm broad with 5 flagella-like appendages at the apex, pedunculate, about 1.5 cm long.

The genus identified by inferior ovary and flagella-like appendages. The remain differs from the living one by lacking the wing-like appendages on the fruit, but as such a character may appear on that from cleistogamous flower, so the remains was identified to be a form of the living.

Further locality in Japan: Clay Bed of Oiwahara in Kaseyama near Kizu, Pref. Kyoto; Lignite Beds of Kowa in Titagun, Pref. Aiti.

Caprifoliaceae

82. *Viburnum japonicum* SPRENG. (Fig. 21 E)

Three seed remains occurred from Simoiguta. Seed elliptic, much flattened, 8 mm long, 4 mm broad, apiculate, one side furrowed.

The shape and size closely resemble to the living one which grow in Southern Japan.

b. MONOCOTYLEDONEAE

Gramineae

83. *Phyllostachys* sp. (Fig. 21 H–I)

Leaves and halm occurred at Inzyo and Itinohora. Leaf about 12 mm broad, petiolate; halm 10–14 mm broad.

The remain may be identified to Bambuseae by stipitate leaves. The halm may be suggested to *Phyllostachys* by its size but no further determination is possible at present.

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V. Explanation of plates IV–VII

(The scales in each figure with mm unit)

Pl. IV. Localities and some remains of Abietineae.

A–B Two cliffs where the Kibusi clay is excavated (Sept. 1939): A Tamodaira: a general view, b closer view; B Inzyo: x bed containing remains.

C–F *Pseudolarix Kaempferi* Gord.

C Scales of cone: a from Inzyo and Itirizuka, b from Huke, Pref. Osaka, c from Sayado in Masiko, Pref. Totigi.

D Branches from Sayado in Masiko, Pref. Totigi.

E Leaves from Inzyo.

F Seeds from Inzyo and Itirizuka.

G Cone of *Pinus Fujiii* Miki from Hatagoya.

H–K *Keteleeria Davidiana* Beissn. from Hatagoya.

H Cones; K leaves; I male cones; J seeds.

L Cones of *Tsuga oblonga* n. sp. from Osusawa.

Pl. V. Taxodiaceae.

A–Ca *Metasequoia disticha* n.g. n. com.

A Cones from Hasimoto, Pref. Wakayama. B Foliaged shoots from Osusawa. Ca Seeds from Hanataka, Pref. Gunma.

D *Metasequoia japonica* n.g. n. com. from Osusawa.

Cb, E–F *Sequoia sempervirens* Endl. from Osusawa excl. Cb from Sidatani, Pref. Mie. E Cones. F Foliaged shoots.

G *Cunninghamia Konishii* Hayata from Osusawa.

H *Glyptostrobus pensilis* Koch.

a Cone bearing shoot from Hitoori, Pref. Hyogo; b cones from Itirizuka; c seeds from Itirizuka.

Pl. VI.

A–B *Liquidambar formosana* Hance.

A Fruits: *a* from Tutimaru, Pref. Osaka; *b* from Simoiguta; *c* from Huke, Pref. Osaka.

B Leaf from Inzyo.

C Seeds of *Stephania Dielsiana* Wu from Simoiguta.

D Nuts of *Carya*.

Da *Carya ovatocarpa* n. sp. from Inzyo.

Db *Carya cathayensis* Sarg. from Inzyo

Dc *Carya nanacarpa* n. sp. from Itinokuraguti.

E Fruits of *Eucommia ulmoides* Oliver from Itinohora.

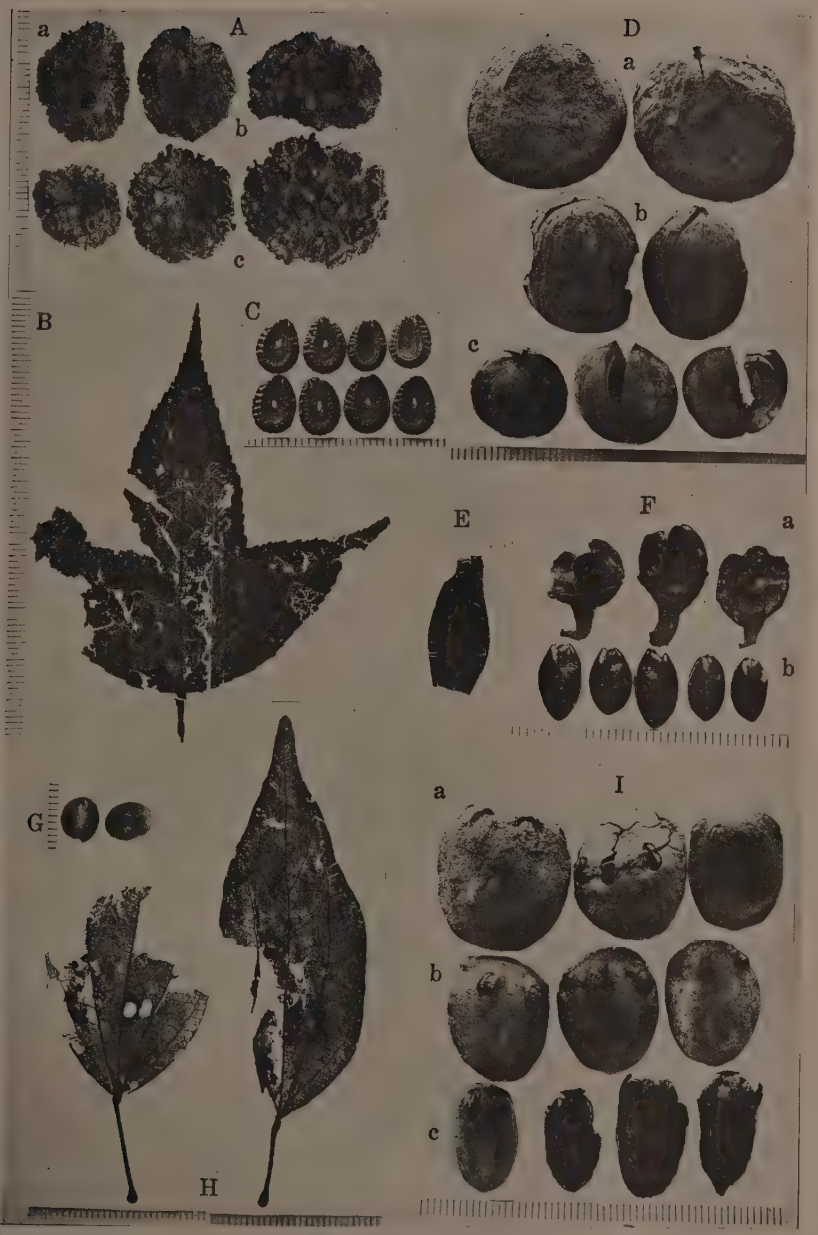
F *Fortunearia sinensis* Rehd. et Wils. from Simoiguta. *a* Capsules. *b* Seeds.

G Seeds of *Schizandra megasperma* n. sp. from Itinohora.

H Leaves of *Mallotus protojaponicus* n. sp. from Inzyo.

(Miki Photo)

(Miki Photo)



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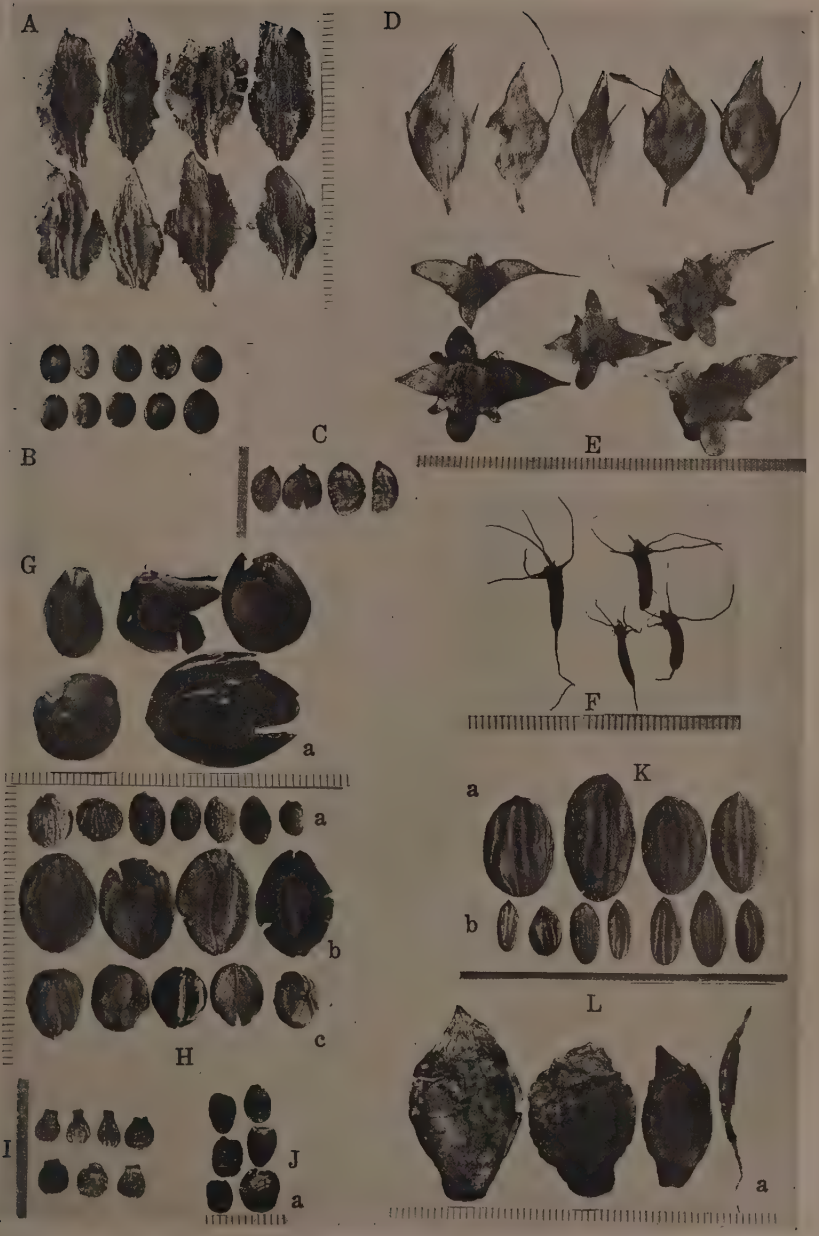

(Miki Photo)

I Endocarps of *Spondias axillaris* ROXB. *b* from Inzyo. *a* var. ***polymeris*** nov. from Inzyo and Hatagoya. *c* var. ***stenocarpa*** nov. from Itinokuraguti.

Pl. VII.

A Fruits of ***Tripterygium multipterium*** n. sp. from Itinokuraguti.
B Seeds of *Brasenia Schreberi* GMEL. from Hatagoya.
C Seeds of ***Cissus megasperma*** n. sp. from Itirizuka.
D Fruits of ***Hemitrapa trapelloida*** n. g. n. sp. from Hatagoya and Akazu.
E Fruits of ***Trapa mammillifera*** MIKI from Itirizuka.
F Fruits *Trapella antennifer* GLÜCK from Hatagoya.
G Seeds of ***Styrax laevigata*** n. sp. from Itinokuraguti excl. *a* from Osusawa.
Ha Seeds of ***Styrax rugosa*** n. sp. from Itinokuraguti.
Hb Seeds of *Styrax Obassia* S. et Z. from Simoiguta.
Hc Seeds of *Styrax Shiraiana* MAKINO from Simoiguta.
I Endocarps of *Symplocos myrtacea* S. et Z. from Itirizuka.
J Endocarps of ***Symplocos tricarpa*** n. sp. from Huke excl. *a* from Hatagoya.
Ka Endocarps of ***Nyssa pachycarpa*** n. sp. from Itinokuraguti.
Kb Endocarps of *Nyssa sylvatica* MARSH from Inzyo.
L Fruits of ***Meliodendron nipponicum*** n. sp. from Inzyo: *a* Young fruit?

VI. Index of the remains

Untersuchungen über die vertikalen phototropischen Bewegungen der Laubblätter von *Fatsia japonica* vom Standpunkt der Wuchsstofflehre

Von Gingoro YAMANE

Hierzu Tafel VIII, 8 Textfiguren u. 9 Tabellen

(Eingegangen am 10. Mai 1941)

1. Einleitung

Es gelang RAYDT (1925), in *Sparmannia*, *Plectranthus* und *Lophospermum* die Aufrichtung und Senkung der Laubblätter durch Verdunkelung der Querzone der wagerechten Lamina unter Oberlicht auszulösen, ohne aber die kausale Erklärung zu finden. Neuerdings hat FISCHNICH (1935) bei *Coleus*-Blättern unter Anwendung künstlichen Wuchsstoffes (Heteroauxin) Bewegungen der Blätter in vertikaler Richtung beobachtet, und durch die Verschiedenheit der Wuchsstoffmenge zwischen der Oberseite und Unterseite des Blattes erklärt.

Bei den Laubblättern von *Fatsia japonica* finden seitliche phototropische Bewegungen bei Beschattung der Längszone der Lamina statt, jedoch bei Beschattung der Querzone, wie ich unten detailliert ausführen werde, vertikale phototropische Bewegungen. Die beiden Arten der Bewegung wurden aber von RAYDT als physiologisch nicht gleichwertig angenommen, weil bei der ersteren das Blatt immer transversal-phototropisch bleibt (*Sparmannia* usw.), dagegen bei der letzteren die ursprüngliche transversal-phototropische Tendenz des Blattes aufgegeben wird. Ich habe in meinen früheren Arbeiten (1938, 1939, 1940) die seitlich-phototropische Bewegung des *Fatsia*-Blattes im Zusammenhang mit der Wuchsstoffwirkung untersucht und kam zu dem Schluss, dass die ungleiche Verteilung des Wuchsstoffes im Stiel dabei die entscheidende Rolle spielt. Nun scheint es mir sehr wahrscheinlich, dass diese beiden Reizerscheinungen, RAYDTs Annahme entgegen, durch nahe verwandte, ja sogar vielleicht physiologisch gleichwertige Vorgänge ausgelöst werden mögen, weil beide nichts anderes als Wachstumsbewegungen sind, die unter dem Einfluss der Lichtverteilung auf der Lamina hervorgerufen werden.

Da auch die durch Verdunkelung der Querzone der Lamina ausgelösten vertikalen Bewegungen, Aufrichtung wie Senkung der Blätter, nach

meiner Anschauung mit der transversal-phototropischen Bewegung im innigsten Zusammenhang stehen und für deren Verständnis fundamentales Material liefern, möchte ich in der vorliegenden Arbeit zunächst RAYDTs Versuche nachprüfen und sie dann unter dem Gesichtspunkt der Wuchsstoffwirkung kausal analysieren. Den transversalen Phototropismus des Blattes gegen das einfallende Licht will ich mit Hilfe der hier gewonnenen Resultate in der nächsten Arbeit eingehender erörtern.

2. Methodik

Als Versuchsmaterial habe ich intakte Blätter von Topfpflanzen der *Fatsia japonica* mit möglichst wagerechten Spreiten verwendet. Die Blattspreite wurden entweder an der Basis oder an der Spitze mit Stanniol bis zur Hälfte dicht bedeckt. Der Blattstiel wurde dabei entweder mit dünnem Stanniol ganz bedeckt oder ganz unbedeckt gelassen. Der Topf mit dem Versuchsblatt wurde in den Versuchskasten eingebracht, indem das Blatt Licht ausschliesslich von oben erhielt. Wenn das Sonnenlicht als Lichtquelle diente, wurde der Kasten durch einen etwa 80 cm hohen Pappenschacht verlängert, sodass die Versuchsspreite nur diffuses Licht von oben erhalten konnte. Die vertikale Bewegung der Spreite wurde durch das Glasfenster an der Vorderwand des Versuchskastens von der Seite beobachtet. Die Registrierung erfolgte durch die Projektion bestimmter Merkmale auf die Glasscheibe des Vorderfensters; und zwar wurde die Bewegung der Glaskapillare auf der Mittelrippe, deren Neigung gegen die Horizontale die Bewegung der Spreite repräsentiert, mit Hilfe des vertikalen Spiegels an der Hinterwand des Versuchskastens genau auf die Glasscheibe des Vorderfensters projiziert, wodurch die Bewegung beobachtet wurde.

Der Wuchsstoffgehalt im bewegten Blatt wurde nach der WENTschen Agardiffusionsmethode durch *Avena*test in der Adaxial- und Abaxialseite des Blattes getrennt bestimmt. Dabei muss die Agarplatte möglichst genau und dicht die Schnittfläche bedecken. Nach zweistündiger Auffangdauer wurde sie in mehrere Würfelchen geteilt und deren Wuchsstoffmenge für die Adaxial- und Abaxialgruppe getrennt geprüft. Für Detail über die Methode der Wuchsstoffbestimmung vergleiche man meine früheren Arbeiten (1939, 1940).

3. Aufrichtung und Senkung des Blattes infolge Verdunkelung der Querzone der Spreite

Ich beschäftigte mich hier zunächst mit der Prüfung des RAYDTschen Versuchs über die vertikalen phototropischen Bewegungen der Blätter (Spreite sowie Stiel), nämlich Aufrichtung und Senkung infolge von

Querzonenbeschattung der Spreite. So sehen wir auch in *Fatsia*-Blättern die Gültigkeit der RAYDTschen Beobachtung, dass die von der Basis zur Hälfte bedeckte Spreite sich senkt, während die von der Spitze verdunkelte sich aufrichtet. Diese Bewegungen der Blattspreite in der vertikalen Richtung schreiten im typischen Fall sehr regelmässig und glatt fort (Tab. 1, Blatt I–III und Tab. 2, Blatt I und II). Aber dies ist nicht

TABELLE 1. Bewegungsweise der Blattspreite mit Basisbeschattung.

	Blatt I	Blatt II	Blatt III	Blatt IV	Blatt V	Blatt VI	Blatt VII
Anfangslage	+* 22°	+ 5°	— 8°	— 19°	0°	0°	+ 15°
Lage nach 1 Tag	+ 22	— 32	— 22	— 63	— 30	+ 12	+ 22
„ 2 Tagen	+ 12	— 58	— 24	— 39	— 41	+ 4	+ 13
„ 3 „	+ 2	— 72	— 25	— 26	— 46	— 3	+ 15
„ 4 „	—* 8	— 76	— 27		— 43	— 5	+ 19
„ 5 „	— 9				— 34	— 12	
Bewegungswinkel	—** 31	— 81	— 19	— 7	— 34	— 12	+** 4

* Bezeichnungen: Senkung unter die Horizontallage mit Vorzeichen —, Hebung mit +.
** Senkung unter die Anfangslage mit Vorzeichen —, Hebung mit +.

TABELLE 2. Bewegungsweise der Blattspreite mit Spitzenbeschattung.

	Blatt I	Blatt II	Blatt III	Blatt IV	Blatt V	Blatt VI	Blatt VII
Anfangslage	0°	—* 9°	+ 3°	+ 20°	+ 5°	+ 17°	0°
Lage nach 1 Tag	+* 16	— 6	+ 10	+ 45	— 3	+ 25	— 17
„ 2 Tagen	+ 21	+ 21	+ 19	+ 41	+ 5	+ 12	— 25
„ 3 „	+ 35	+ 26	+ 20	+ 30	+ 9	+ 3	— 45
„ 4 „	+ 44		+ 15	+ 35	+ 20	— 3	— 35
„ 5 „			+ 11	+ 29	+ 21	— 10	— 32
Bewegungswinkel	+** 44	+ 35	+ 7	+ 9	+ 16	—** 27	— 32

* & ** Bezeichnungen: Siehe Tabelle 1.

immer der Fall. Ein Blatt mit Querzonenbeschattung an der Basis kann sich oft auch erst ziemlich weit heben, um dann allmälich sich wieder zu senken (Tab. 1, Blatt VI). Ausserdem wurde öfters nach Erreichung der maximalen Lage die Rückkehr der Bewegung nach der Anfangslage in mehr oder weniger starkem Grad beobachtet (Tab. 1, Blatt IV and V). Solche Uneinheitlichkeit der Bewegungsweise liess sich auch bei der Auf-

richtung der Spreite mit Spitzenverdunkelung beobachtet (Tab. 2, Blatt III, IV und V). Die Endlage der Spreite ergab jedoch, dass die Basisbeschattung immer eine Senkung auslöst. In meinen Versuchen wurde

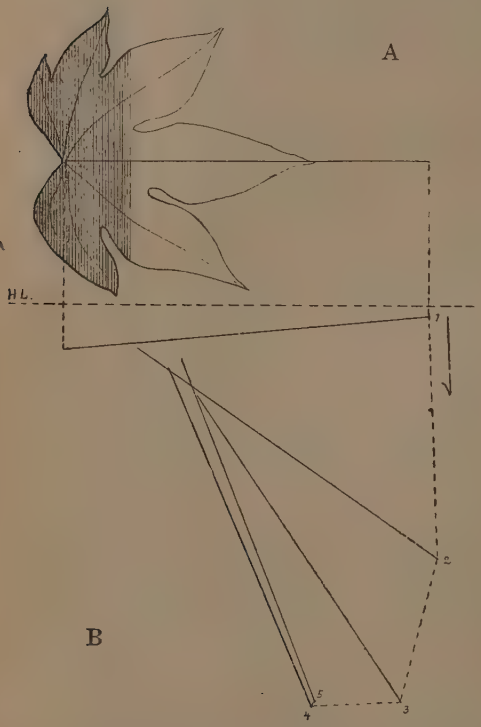

Fig. 1. Senkung der Blattspreite infolge der Basisbeschattung.

A. Beschattungsweise.
B. Bewegungsweise der Mittelrippe, vertikale Projektion der Bewegung des Blattes.

Siehe Tab. 1, Blatt II.
HL. Horizontallinie.

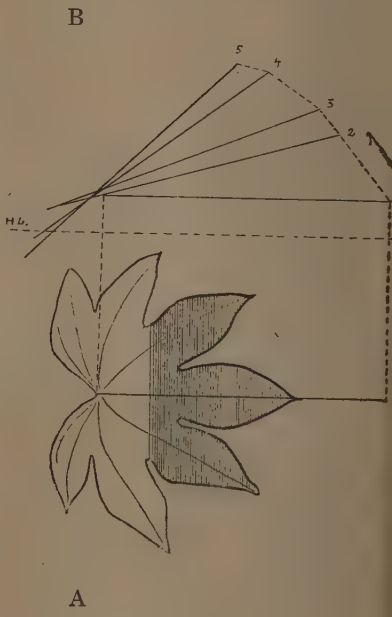

Fig. 2. Aufrichtung der Blattspreite infolge Spitzenbeschattung.

A. Beschattungsweise.
B. Bewegungsweise der Mittelrippe, vertikale Projektion der Bewegung des Blattes.

Siehe Tab. 2, Blatt I.
HL. Horizontallinie.

nur einzige Ausnahme beobachtet, bei der die Spreite mit Basisverdunkelung sich aufrichtet, aber der Bewegungswinkel war sehr klein und betrug nur $+4°$[1] (Tab. 1, Blatt VII), wogegen alle anderen 23 Versuchsblätter sich

(1) Bezeichnungen: Senkung unter die Anfangslage in Winkelgrad mit Vorzeichen—, Hebung mit+.

beträchtlich senkten: der Bewegungswinkel in der Endlage beträgt durchschnittlich −22.3°. Bei der Spitzenbeschattung ist allerdings das Verhältnis zwischen der Beschattungsweise und Bewegungsrichtung nicht so regelmässig wie bei der Basisbeschattung, indem nämlich eine Anzahl von Blättern sich infolge der Spitzenbeschattung aufrichteten, während andere Blätter sich merklich senkten, oft sogar beträchtlich. Unter 50 Versuchsblättern richteten sich 28 Blätter infolge der Spitzenbeschattung auf, und der Bewegungswinkel betrug durchschnittlich +15.7°, während 22 Blätter sich senkten, bei einem durchschnittlichen Bewegungswinkel von −19°. Auf diese Störung in der Regelmässigkeit der Bewegungsweise bei Spitzenbeschattung, die wir bei RAYDT nicht gefunden haben, werde ich später noch zurückkommen.

Beispiele der Senkung des Blattes infolge Basisbeschattung in Tab. 1, Fig. 1 im Text und Fig. 1, A in Tafel VIII und Beispiele der Aufrichtung infolge Spitzenbeschattung in Tab. 2., Fig. 2 im Text und Fig. 1, B in Tafel VIII gezeigt.

4. Wuchsstoffverteilung in den aufgerichten und gesenkten Blättern

Die beobachtete Aufrichtung oder Senkung der Blattspreite beruht ohne Zweifel auf der Wachstumsbewegung des Blattstiels, weil beim aufgerichteten Blatt im Blattstiel eine adaxial konkave Krümmung eintritt, dagegen beim Blatt eine adaxial konvexe. RAYDT beobachtete diese Krümmung des Blattstiels bei der Aufrichtung nur im untersten gelenkartig angeschwollenen Ende des Stiels, bei der Senkung sowohl im untersten als auch im obersten Ende des Stiels. In *Fatsia*-Blättern die Bewegungsfähigkeit des Stiels nicht immer in solcher Weise lokal beschränkt; in jungen Blättern ist eine Krümmung in allen Teilen des Stiels möglich, und die lokale Beschränkung der Bewegungsfähigkeit tritt erst in älteren Blättern auf. Allerdings löst die ungleiche Verteilung des Lichtes in der Querzone der Lamina Wachstumsdifferenzen in der Adaxial- und Abaxialseite des Stiels aus. Wie ist das möglich? In welcher Weise wird der auf der Lamina ausgeübte Lichtreiz nach dem Stiel geleitet und dort wirksam? Diese Frage bleibt bei RAYDT leider noch unberührt, aber es scheint mir, dass dies den wichtigsten und interessantesten Punkt bildet und dass Klarheit über die Verteilung des Wuchsstoffes im Blatt den ersten und besten Schlüssel zur Lösung bieten muss.

Um die Wuchsstoffverteilung im bewegten Blatt zu ermitteln, wurde der gekrümmte Stiel am Krümmungsort mit einem Rasiermesser einige Millimeter lang in Adaxial- und Abaxialseite gespalten und dann der Wuchsstoff, der sich aus jeder der Stielhälften in die Agarplatte auf der

Schnittfläche diffundierte, durch *Avena*test bestimmt. Das Resultat ergab sich eindeutig, dass in den gesenkten Blättern mit Basisbeschattung mehr Wuchsstoff in der Adaxialseite, dagegen in den aufgerichteten Blättern mit Spitzenbeschattung mehr in der Abaxialseite gefunden wurde. Das

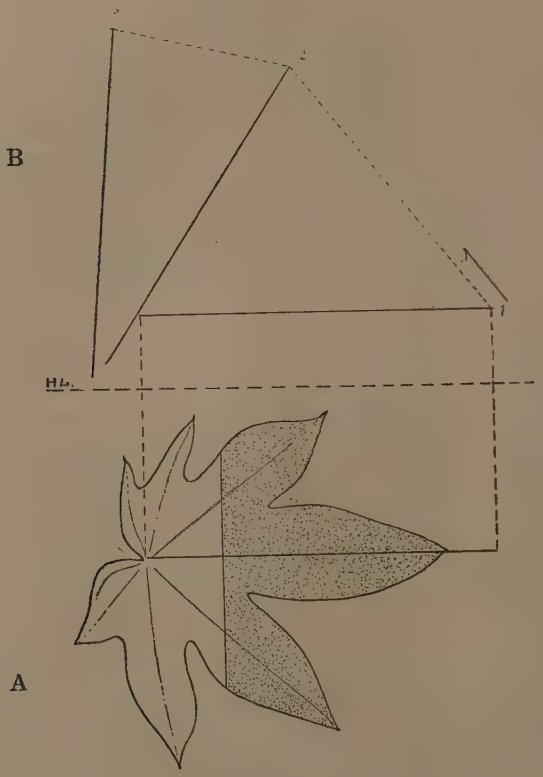

Fig. 3. Aufrichtung der Blattspreite infolge Spitzenbestreichung mit Heteroauxinpaste.
A. Bestreichungsweise.
B. Bewegungsweise der MR. (Mittelrippe). Vertikale Projektion.
1. Anfangslage. 3. Lage nach 2 Tagen.
2. Lage nach 1 Tag. HL. Horizontallinie.

Verhältnis der Wuchsstoffmengen in der Adaxial- und Abaxialseite (Ad : Ab) ist im ersteren Fall (Senkung) 63.9 : 36.1 (Tab. 3), im letzteren Fall (Aufrichtung) 38.7 : 61.3 (Tab. 4). In der anderen Versuchsserie beträgt es im Fall der Senkung Ad : Ab 61.7 : 38.2, in dem der Aufrichtung 41.4 : 58.6.

TABELLE 3. Wuchsstoffverteilung im Blatt, welches infolge Basisbeschattung sich gesenkt hat.

Versuchsnummer	Krümmungen der *Avena*koleoptilen		Verhältnis der Wuchsstoffmenge		Krümmung des Blattstiels	Bewegung der Blattspreite
	Adaxialseite	Abaxialseite	Adaxialseite	Abaxialseite		
			%	%		
1	6.8°	2.3°	74.5	25.5	— °	—27°
2	11.8	13.8	46 1	53.9	—20	—65
3	6.5	4.0	61.4	38.6	—11	—34
4	12.0	5.8	72.4	27.6	—20	—25
5	9.8	5 3	64.2	35.8	—31	—74
6	9.0	5.0	64.3	35.7	—13	—19
7	11.0	4.0	73 3	26.7	—13	—
8	9.5	4.8	66.4	33.6	—15	—15
9	11.0	5.5	70.9	29.1	—15	—
10	13.0	6.0	68.4	31.6	—24	—22
11	18.3	19.0	49.1	50.9	—	—31
12	10.8	8.5	55.9	44.1	— 8	—12
Durchschnitt			63.9±2.7	36.1±2.7	—17	—32

TABELLE 4. Wuchsstoffverteilung im Blatt, welches infolge Spitzenbeschattung sich aufgerichtet hat.

Versuchsnummer	Krümmungen der *Avena*koleoptilen		Verhältnis der Wuchsstoffmenge		Krümmung des Blattstiels	Bewegung der Blattspreite
	Adaxialseite	Abaxialseite	Adaxialseite	Abaxialseite		
			%	%		
1	8.5°	11.0°	43.5	56.5	+21°	+24°
2	7.8	9.3	45.6	54.4	+ 7	+35
3	6.5	10.0	39.4	60.6	—	+28
4	4.5	8.0	36.0	64.0	+10	+ 7
5	7.0	10.5	41.7	58.3	+10	+26
6	6.0	2.0	24.1	75.9	+ 6	+44
7	10.5	15.0	41.2	58.8	+23	+27
8	4.5	8.8	33.3	66.7	+11	+26
9	3.5	7.5	31.8	68.2	+ 8	+32
10	8.5	18.0	32.1	67.9	+13	+10
11	11.0	9.0	55.0	45.0	+15	+21
12	5.0	7.3	40.7	59.3	+ 5	+22
Durchschnitt			38.7±2.3	61.3±2.3	+12	+26

Zum Vergleich habe ich den Bewegungswinkel der Spreite und den Krümmungswinkel des Stiels als die siebenten und sechste Kolonne in Tabelle 3 und Tabelle 4 zusammengestellt, konnte daraus aber keine einheitlichen Zahlenverhältnisse zwischen diesen und dem Wert Ad: Ab feststellen (YAMANE, 1940).

5. Aufrichtung und Senkung der Blätter durch partielle Bestreichung mit künstlichem Wuchsstoff

Wie oben erwähnt, haben wir bei Spitzenbeschattung eine Zunahme an Wuchsstoff in der Abaxialseite und bei Basisbeschattung eine

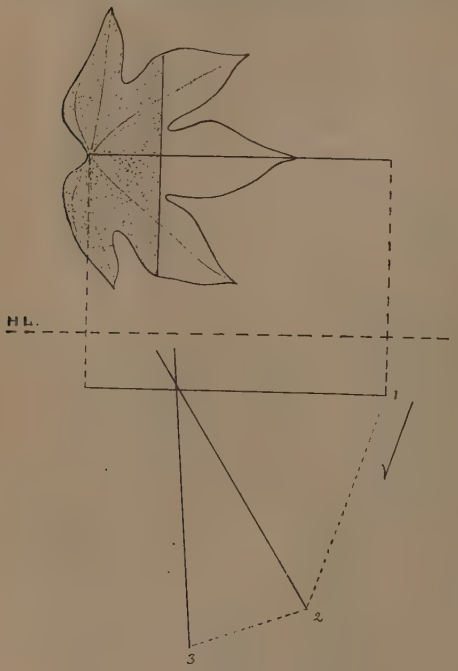

Fig. 4. Senkung der Blattspreite infolge Basisbestreichung mit Heteroauxinpaste.

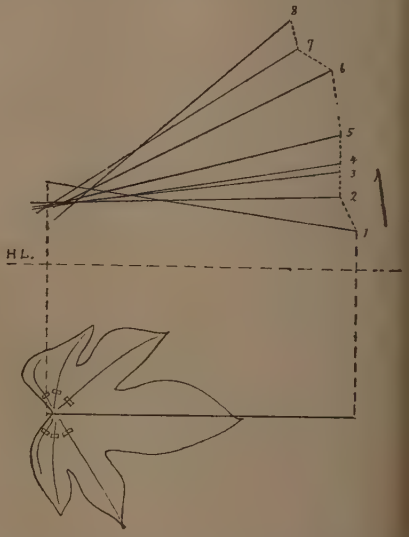

Fig. 5. Aufrichtung der Blattspreite infolge Durchschneidens der äusseren Rippen.
1. Anfangslage.
2. Lage nach 1 Tag.
3. „ „ 2 Tagen.
4. „ „ 3 Tagen.
5. „ „ 4 Tagen.
6. „ „ 5 Tagen.
7. „ „ 6 Tagen.
8. „ „ 7 Tagen.

Zunahme in der Adaxialseite festgestellt. Dies scheint mir zu bedeuten, dass die beiden Arten der Bewegung auf eine Verschiedenheit in der Lieferung vom Wuchsstoff von der Spreite nach dem Stiel zurückgeführt

werden müssen, und es handelt sich nun darum zu bestimmen, in welcher Weise diese vor sich geht. Zu diesem Zweck wurde der künstliche Wuchsstoff, Heteroauxin, in Form von Paste 1/1 (vgl. LAIBACH, 1935) auf die etiolierte Spreite[1] von *Fatsia*-Blättern gebracht, einmal an der Spitze und einmal an der Basis. Es ergab sich, dass die Spreite sich bei Spitzenbestreichung, wie aus Fig. 2, Tafel VIII und Fig. 4 im Text ersichtlich, aufrichtete und der Stiel sich adaxialkonkav krümmte, während bei Basisbestreichung, wie in Fig. 2, Tafel VIII und Fig. 5 im Text dargestellt, die Spreite sich senkte und der Stiel sich abaxialkonkav krümmte. Dies ist auch leicht begreiflich aus dem Resultat der im folgenden ausgeführten Wuchsstoffbestimmung, wobei die grössere Wuchsstoffmenge bei Basisbestreichung in der Adaxialseite, bei Spitzenbestreichung in der Abaxialseite gefunden wurde. Das Zahlenverhältnis für beide Seiten des Stiels (Ad : Ab) ist im ersteren Fall 61.5 : 39.5 (Tab. 5) und im letzteren 40.4 : 59.6 (Tab. 6). Es wurde mir nun klar, das im Stiel von dem Wuchs-

TABELLE 5. Wuchsstoffverteilung im Blatt, welches infolge Basisbestreichung mit Wuchsstoffpaste sich gesenkt hat.

Versuchsnummer	Krümmungen der *Avena*koleoptilen		Verhältnis der Wuchsstoffmenge		Krümmung des Blattstiels	Bewegung der Blattspreite
	Adaxialseite	Abaxialseite	Adaxialseite	Abaxialseite		
			%	%		
1	18.5°	15.5°	54.4	45.6	−17°	— °
2	11.0	11.0	50.0	50.0	−32	−109
3	12.8	8.0	61.5	38.5	−17	— 37
4	9.0	7.5	54.5	45.5	−12	— 37
5	6.5	1.0	86.6	13.4	— 9	— 40
6	8.0	5.0	61.5	38.5	−24	— 38
7	21.0	18.0	53.8	46.2	−23	— 29
8	17.0	5.5	75.5	24.5	−15	— 41
9	15.0	17.0	46.8	53.2	−30	— 54
10	12.3	5.0	71.1	28.9	−10	—
Durchschnitt			61.6±4.0	38.4±4.0	−19	— 48

stoff, der an die Spitze geliefert wurde (oder in der Spitze vorhanden war), mehr in die Abaxialseite, dagegen von dem an die Basis gelieferten mehr in die Adaxialseite hineinströmt.

Die völlige Übereinstimmung zwischen den Heteroauxinversuchen und den Querzonenbeschattungsversuchen, sowohl in der Bewegungsweise

(1) Etiolierung erleichtert das Eindringen des Wuchsstoffes in das Gewebe der Spreite.

TABELLE 6. Wuchsstoffverteilung im Blatt, welches infolge Spitzenbestreichung mit Wuchsstoffpaste sich aufgerichtet hat.

Versuchsnummer	Krümmungen der *Avena*koleoptilen		Verhältnis der Wuchsstoffmenge		Krümmung des Blattstiels	Bewegung der Blattspreite
	Adaxialseite	Abaxialseite	Adaxialseite	Abaxialseite		
			%	%		
1	11.2°	19.7°	36.3	63.7	+22°	+86°
2	12.0	15.0	44.5	55.5	+19	+85
3	5.7	8.5	40.0	60.0	+36	—
4	6.5	9.0	42.0	58.0	+13	+46
5	5.5	9.0	38.0	62.0	+ 7	+43
6	6.0	7.0	46.2	53.8	+ 4	+25
7	7.0	11.0	38.9	61.1	+11	+71
8	6.0	9.0	40.0	60.0	+12	—
9	6.0	12.0	33.4	66.6	+10	—
10	12.0	15.0	44.5	55.5	+10	+18
Durchschnitt			40.4±1.3	59.6±1.3	+14	+53

TABELLE 7. Wuchsstoffverteilung im Blatt, welches infolge entweder Basis- oder Spitzenbestreichung auf der Unterseite der Spreite sich gesenkt hat.

Versuchsnummer		Krümmungen der *Avena*koleoptilen		Verhältnis der Wuchsstoffmenge		Krümmung des Blattstiels	Bewegung der Blattspreite
		Adaxialseite	Abaxialseite	Adaxialseite	Abaxialseite		
				%	%		
Basaler Teil der Blattspreite wurde mit Heteroauxin bestrichen	1	0.5°	5.5°	* 8.4	*91.6	+23°	+38°
	2	3.0	9.8	23.5	76.5	+ 8	+12
	3	4.5	8.3	35.0	64.0	+ 3	+ 4
	4	7.3	8.0	47.7	52.3	+10	+10
	5	3.4	8.0	30.0	70.0	+17	+20
	Durchschnitt			34.3±5.1	65.7±5.1	+12	+17
Apikaler Teil der Spreite wurde mit Heteroauxin bestrichen	1	5.5	7.8	40.7	59.3	+32	+91
	2	3.0	9.0	26.6	73.4	+15	+61
	3	2.0	7.0	22.2	77.8	±14	+56
	4	4.0	10.5	27.6	72.4	+18	+76
	5	9.7	6.5	59.7	40.3	+22	+60
	Durchschnitt			35.3±6.8	64.3±6.8	+20	+69

* Beim Durchschnitt nicht hinzugezählt.

wie im Verhältnis der Wuchsstoffverteilung, hat mir die Herrschaft des Wuchsstoffes über die vertikalen Bewegungen der Blätter ziemlich einwandfrei erwiesen. Es kann als sehr wahrscheinlich angenommen werden, dass auch bei Querzonenbeschattung der verdunkelte Teil der Lamina mehr Wuchsstoff nach dem Stiel sendet als der beleuchtete Teil, ebenso wie es bei der Längszonenbeschattung der Fall war. Bei Längszonebeschattung wird der Wuchsstoff in der verdunkelten Hälften durch die Rippen desselben Teils nach derselben Seite des Stiels geleitet. Wie aber der Wuchsstoff in der Spitze der Spreite nach der Abaxialseite des Stiels und der in der Basis nach der Adaxialseite geleitet wird, ist eine Frage, die nun vor allem beantwortet werden muss.

In Bezug auf die Heteroauxinversuche auf der Unterseite der Spreite liegen die Dinge etwas anders. Die Blattspreite, deren Unterseite an der Basis mit Heteroauxin betrichen wurde, richten sich auf, ebenso wie die an der Spitze behandelten (Fig. 3, Tafel VIII). Das Verhältnis der Wuchsstoffmenge in der Adaxial- und Abaxialseite des Stiels war im ersteren Fall 34.3 : 65.7 und im letzteren Fall 35.3 : 64.7 (Tab. 7). Es ergibt sich daraus, dass die hier beobachtete Aufrichtung der Spreite mit Basisbestreichung nicht mit der Bewegungsweise bei Basisbestreichung der Oberseite übereinstimmt. Hiervon wird auch noch die Rede sein.

6. Erklärung der Transportweise des Wuchsstoffes von der Spitze und Basis der Spreite nach dem Stiel

Da die Rippen die Transportbahnen für den Wuchsstoff von der Spreite nach dem Stiel sind, scheint es mir nach der obigen Feststellung sehr wahrscheinlich, dass die äusseren, im basalen Teil der Spreite liegenden Rippen in die Adaxialseite des Stiels hineinmünden und damit von der Basis der Spreite mehr Wuchsstoff nach der Adaxialseite des Stiels liefern, und dass degegen die inneren Rippen, die bis zum apikalen Teil der Spreite reichen, in die Abaxialseite des Stiels hineinmünden und infolgedessen in der Spitze der Spreite mehr Wuchsstoff nach der Abaxialseite liefern. Diese Annahme wurde durch die Rippenversuche in der folgenden Weise bestätigt, dass durch das Durchschneiden der äussere Rippen die Aufrichtung der Spreite (Fig. 4 in Tafel VIII und Fig. 5 im Text), durch das Durchschneiden der inneren Rippen die Senkung ausgelöst wurde (Fig. 4 in Tafel VIII und Fig. 6 im Text). Zugleich lehrte uns die dabei ausgeführte Wuchsstoffbestimmung, dass bei den Blättern, die sich nach Durchschneiden der inneren Rippen gesenkt hatten, mehr Wuchsstoff in der Adaxialseite des Stiels fanden, dagegen bei den Blättern, die sich nach Durchschneiden der äusseren Rippen aufgerichtet hatten, mehr in der Abaxialseite. Das Mengenverhältnis des Wuchsstoffes in den

beiden Seiten des Stiels (Ad : Ab) betrug, wie es Tab. 8 und Tab. 9 zeigen, im ersteren Fall 68.8 : 31.2 und im letzteren Fall 33.7 : 66.3.

Dies beruht nach meiner Anschauung darauf, dass der Transport des Wuchsstoffes im apikalen Teil der Spreite durch Durchschneiden der inne-

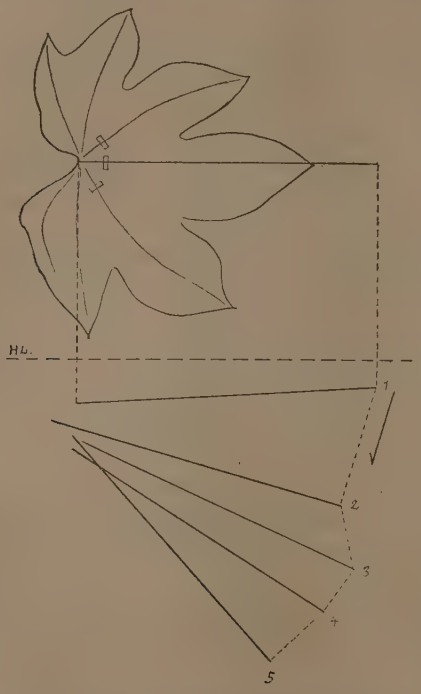

Fig. 6. Senkung der Blattspreite infolge Durchschneidens der inneren Rippen.

1. Anfangslage.
2. Lage nach 1 Tag.
3. „ „ 2 Tagen.
4. Lage nach 3 Tagen.
5. „ „ 4 Tagen.

ren Rippen gestört werden muss, während die Wuchsstoffströmung von der Basis der Spreite durch die intakten äusseren Rippen ungestört fortschreitet, und diese Erklärung bestätigt auch die These, dass die äusseren Rippen in die Adaxialseite des Stiels und die inneren Rippen in die Abaxialseite hineinmünden und dort den Wuchsstoff transportieren müssen. Ferner muss die Aufrichtung der Spreite und der Überschuss des Wuchsstoffes in der Abaxialseite nach Durchschneiden der äusseren Rippen in ähnlicher Weise zu erklären sein. Auch die anatomischen Untersuchun-

TABELLE 8. Wuchsstoffverteilung im Blatt, welches infolge Durchschneidens der inneren Rippen sich gesenkt hat.

Versuchsnummer	Behandlungsweise	Krümmungen der *Avena*koleoptilen		Verhältnis der Wuchsstoffmenge		Krümmung des Blattstiels	Bewegung der Blattspreite
		Adaxialseite	Abaxialseite	Adaxialseite	Abaxialseite		
				%	%		
1	3 IR.* durchgeschnitten	9.0°	4.0°	69.3	30.7	−20°	−19°
2	3 „ „	5.0	3.0	62.5	37.5	− 6	−18
3	3 „ „	5.0	1.5	77.0	23.0	−25	−42
4	3 „ „	5.0	1.5	77.0	23.0	−10	−20
5	3 „ „	9.0	6.5	58.1	41.9	—	−48
6	3 „ „	6.5	3.0	70.0	30.0	−17	−35
7	3 „ „	10.0	2.0	83.3	16.7	−15	−58
8	3 „ „	6.5	2.0	76.4	23.6	− 8	−22
9	1 „ „	5.5	4.3	56.1	43.9	− 6	−38
10	1 „ „	11.0	4.7	68.4	31.6	−14	−61
Durchschnitt				69.8±2.8	30.2±2.8	−13	−36

* I R: Innere Rippen.

TABELLE 9. Wuchsstoffverteilung im Blatt, welches infolge Durchschneidens der äusseren Rippen sich aufgerichtet hat.

Versuchsnummer	Behandlungsweise	Krümmungen der *Avena*koleoptilen		Verhältnis der Wuchsstoffmenge		Krümmung des Blattstiels	Bewegung der Blattspreite
		Adaxialseite	Abaxialseite	Adaxialseite	Abaxialseite		
				%	%		
1	6 ÄR.* durchgeschnitten	4.0°	5.5°	42.1	57.9	+ 3°	+12°
2	6 „ „	6.0	9.0	40.0	60.0	—	+52
3	6 „ „	3.0	6.0	33.4	66.6	+10	+30
4	6 „ „	5.0	10.0	33.4	66.6	+ 6	+62
5	6 „ „	5.0	6.5	47.8	52.2	—	—
6	6 „ „	2.3	9.5	19.5	80.5	—	—
7	4 „ „	7.3	6.6	52.4	47.6	—	+22
8	4 „ „	6.0	15.0	28.6	71.4	+ 3	+53
9	4 „ „	4.0	5.5	42.1	57.9	+ 6	+11
10	4 „ „	3.5	7.0	33.4	66.6	+ 9	+25
Durchschnitt				37.1±3.0	62.8±3.0	+ 6	+33

* ÄR: Äussere Rippen.

gen über den Rippenverlauf deuteten auf die Richtigkeit dieser Erklärungsweise hin; davon wird später noch die Rede sein.

Das teilweise Abschneiden der Spreite an der Spitze oder an der Basis kann auch die Bewegungen in der vertikalen Richtung auslösen. Im ersteren Fall senkt sich die Spreite (Fig. 7), wogegen im letzteren Fall,

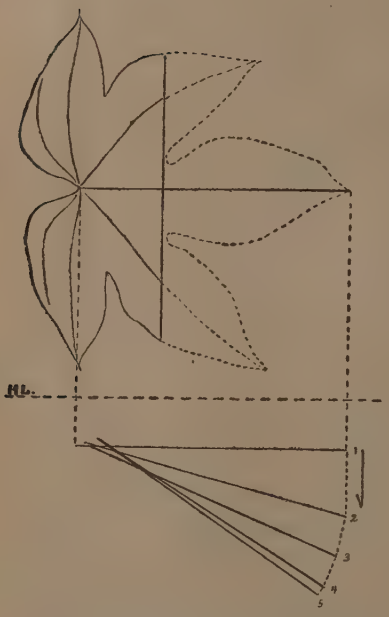

Fig. 7. Senkung der Blattspreite infolge Abschneidens der Spitze der Spreite (der punktierte Teil wurde abgeschnitten).
1. Anfangslage
2. Lage nach 1 Tag.
3. „ „ 2 Tagen.
4. „ „ 3 Tagen.
5. „ „ 4 Tagen.

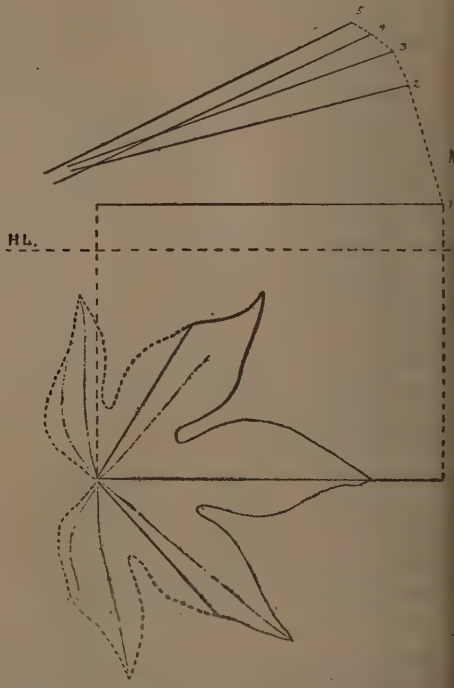

Fig. 8. Aufrichtung der Blattspreite infolge Abschneidens der Basis der Spreite (der punktierte Teil wurde abgeschnitten).
1. Anfangslage
2. Lage nach 1 Tag.
3. „ „ 2 Tagen.
4. „ „ 3 Tagen.
5. „ „ 4 Tagen.

wenn die beiden äusseren Teile der Spreite seitlich der Mittelrippe, in der Basis beseitigt wurden, die Spreite sich aufrichtete (Fig. 8). Wiederum ergab sich dabei ungleiche Verteilung des Wuchsstoffes im Stiel; bei Abschneiden der Spitze war Ad : Ab 63.5 : 36.5, bei Abschneiden der Basis 35.0 : 65.0. In diesem Fall mögen beide Bewegungen auf den Mangel an

Wuchsstoffes in einer der konkaven Seite des Stiels zurückzuführen sein, indem das teilweise Abschneiden der Spreite die Quelle für die Wuchsstoffbelieferung der konkaven Seite beseitigt.

7. Besprechung der Versuche

Aus dem oben erwähnten können wir schliessen, dass die hier beobachtete Aufrichtung und Senkung der Spreite Arten der Wachstumsbewegung sind, deren Bewegungsweise auf dem Zustand der Wuchsstoffverteilung im Stiel zurückzuführen sind. Der Lichtreiz, der auf der Lamina ausgeübt wird, kann nur auf dem Wege über eine Veränderung der Wuchsstoffverteilung im Stiel eine Reaktion auslösen. Wie aber der Lichtreiz, der ja nichts anders als das Ergebnis ungleicher Lichtverteilung in den Querzonen der Lamina ist, die Wuchsstoffverteilung im Stiel beherrschen kann, muss nun den wichtigsten und interessantesten Gegenstand der vorliegenden Arbeit bilden.

Hierzu ist zu sagen, dass bei Spitzenbeschattung die Aufrichtung der Spreite dadurch ermöglicht wird, dass durch das erhöhte Wuchsstofflieferungsvermögen des Spitzenteils unter Mitwirkung der dort verteilten inneren Rippen mehr Wuchsstoff nach der Abaxialseite des Stiels, bei Basisbeschattung die Senkung dadurch, dass durch das erhöhte Wuchsstofflieferungsvermögen des Basisteils mit Hilfe der äusseren Rippen mehr Wuchsstoff nach der Adaxialseite des Stiels gesandt wird. Das gründet sich darauf, dass erstens bei Spitzenbeschattung im Stiel mehr Wuchsstoff in der Abaxialseite des Stiels, dagegen bei Basisbeschattung mehr in der Adaxialseite entdeckt wurde (siehe die Wuchsstoffbestimmung in den aufgerichteten und gesenkten Blättern); dass zweitens der an die Spitze zugefügte Wuchsstoff nach der Abaxialseite des Stiels, dagegen der an die Basis zugefügte nach der Adaxialseite gesendet wurde (teilweise Bestreichung mit Heteroauxin); dass drittens die inneren Rippen, die bis zur Spitze der Spreite reichen, in die Abaxialseite, und die äusseren Rippen, die in der Basis verteilt sind, in die Adaxialseite des Stiels hineinmünden (teilweises Durchschneiden der Rippen). Also spielen die Rippen hierbei eine wesentliche Rolle. Diesbezüglich lieferte auch die anatomische Untersuchung der Gefässbündel im Stiel, wie ich oben schon angedeutet habe, ein wichtiges Argument, indem sie klarstellte, dass die inneren Rippen in die Abaxialseite des Stiels, die äusseren Rippen in die Adaxialseite, und die übrigen, dazwischen liegenden Rippen in den seitlichen Teil des Stiels hineinmünden. Dies erwies sich dadurch, dass von der Mittelrippe her eingezogene verdünnte Eosinlösung das Gefässbündel im Stiel in der Abaxialseite rot färbte, dagegen von der äusseren Rippe her eingezogene Lösung das Gefässbündel in der Adaxialseite. Da die Rippen die Tranportbahn des Wuchsstoffes sein dürfen, wird die obige Auffassung

über den Bewegungsmechanismus der Aufrichtung und Senkung der Spreite durch diese anatomische Beziehung stichhaltig begründet. Details über den Rippenverlauf will ich aber in meiner späteren Arbeit an Hand von Figuren eingehender darstellen.

Um diese Art, die Bewegungen zu erklären, auf ihre Richtigkeit nachzuprüfen, wurden folgende Versuche unternommen: erstens wurden die spitzen Enden zu beiden Seiten der Basis der Spreite beschattet, und es wurde nicht Aufrichtung, sondern Senkung hervorgerufen wie bei der üblichen Basisbeschattung, doch in geringerem Masse. In diesem Fall wurden also nur die Spitzen der unteren Spreitenlappen verdunkelt, das heisst, nicht, wie bei der normalen Spitzenbeschattung, die inneren Rippen, sondern nur, wie bei der normalen Basisbeschattung, die äusseren Rippen, und zwar nur ihre apikalen Teile. Aus dem Ergebnis dieses Versuchs ist zu schliessen, dass nicht allein die Polarität des verdunkelten Spreitenteils für die Bewegung ausschlaggebend ist, sondern auch die Frage, welche Rippe dabei verdunkelt wird. Wenn dabei die handförmige Rippenanordnung der *Fatsia*-Blätter in Betracht gezogen wird, so ist nicht zu übersehen, dass bei normaler Basisbeschattung die äusseren Rippen, bei normaler Spitzenbeschattung die inneren Rippen (und zwar nur ihre Spitzenteile) verdunkelt werden. Tatsache scheint also zu sein, dass für die Aufrichtung die Verdunkelung der inneren Rippen, für die Senkung die der äusseren Rippen entscheidend ist. Oder genauer gesagt, wird die Aufrichtung der Spreite stets dadurch ausgelöst, dass durch das erhöhte Lieferungsvermögen der inneren Rippen mehr Wuchsstoff nach der Abaxialseite, und die Senkung dadurch, dass durch die äusseren Rippen mehr Wuchsstoff nach Adaxialseite des Stiels gesandt wird. Diese Erhöhung des Lieferungsvermögens kann sowohl durch Verdunkelung der Rippen selbst als auch allein durch Verdunkelung ihres parenchymatischen Teils (einschliesslich der kleinen Netzrippen) bewirkt werden. In der Tat kann die Bewegung sowohl durch Verdunkelung der Rippen allein als auch durch partielle Verdunkelung des parenchymatischen Teils der Spreite allein ausgelöst werden, nämlich durch Beschattung der inneren Rippen oder des ihnen benachbarten parenchymatischen Teils die Aufrichtung, und durch Verdunkelung der äusseren Rippen oder des ihnen benachbarten parenchymatischen Teils die Senkung. Wie aber vermag die Verdunkelung eine Erhöhung des Wuchstoff-Lieferungsvermögens zu bewirken? Steigt es absolut durch Neuproduktion oder Aktivierung von Wuchsstoff im verdunkelten Teil, oder nur relativ durch Zerstörung von Wuchsstoff oder Entstehung von Hemmungsstoff im nicht verdunkelten Teil, oder zweifach durch Verschiebung von Wuchsstoff aus dem nicht verdunkelten nach dem verdunkelten Teil (und also Abnahme in nicht verdunkelten Teil bei gleichzeitiger Zunahme im verdunkelten Teil). Oder

wird es realisiert durch Erhöhung des Transportvermögens der Rippen selbst? Die entscheidende Antwort auf diese Frage muss die Zukunft bringen.

Zweitens, wurde die oben festgestellten Verhältnisse durch Versuche unter Bestreichung mit Heteroauxinpaste nachgeprüft und wiederum bestätigt gefunden, indem die Spreite sich senkte, wenn die Spitze der unteren Spreitenteile bestrichen wurden. Anderseits wurden die Bewegungen auch dann ausgelöst, wenn die Rippen allein mit Heteroauxinpaste bestrichen wurden: nämlich die Aufrichtung der Spreite bei Bestreichung der Mittelrippe, in ihrer ganzen Länge oder auch nur in ihrem basalen oder nur in ihrem apikalen Teil. Im ersteren Fall war die Bewegung am deutlichsten und ihre Geschwindigkeit am grössten. Im letzteren Fall war darauf zu achten, dass die Bestreichung möglichst schmal auf die Mittelrippe selbst beschränkt bleibt, da sonst das aufgetragene Heteroauxin von den benachbarten äusseren Rippen absorbiert wurde und die Aufrichtung hemmt, indem nämlich in der Blattbasis alle, äussere wie innere, Rippen nahe zusammenlaufen. Bei entsprechender Bestreichung der äusseren Rippen wurde die Senkung der Spreite hervorgerufen und die Wuchsstoffverteilung im Stiel betrug bei Bestreichung nur der apikalen Teile der äusseren Rippen Ad: Ab=62.1: 37.9 (Bewegungswinkel −82°), bei teilweiser Bestreichung nur der basalen Rippenteile Ad: Ab=67.9: 32.1 (Bewegungswinkel −45°).

Drittens, wurde beobachtet, dass bei Durchschneiden der Rippen der normale Verlauf der durch Bestreichung mit Heteroauxin ausgelösten Aufrichtung oder Senkung gestört wurde, und zwar vermochten sich bei Bestreichung der Spitze und Durchschneiden der inneren Rippen die Spreite nicht aufrichten, sondern senkte sich (Bewegungswinkel −20°, Ad: Ab=66.7: 33.3), während die intakte Spreite mit bestrichener Spitze sich merklich aufrichtete (Bewegungswinkel +55°, Ad: Ab=42.6: 57.4). Entsprechende Versuche mit Bestreichung der Basis ergaben bei Durchschneiden der äusseren Rippen eine weit schwächere Senkung als bei der intakten Spreite (−19°), und zuweilen sogar eine deutliche Aufrichtung (+37°). Das Wuchsstoffverhältnis war für das schwach gesenkte Blatt Ad: Ab=53.1: 46.9, beim aufgerichteten Blatt Ad: Ab=38.0: 62.0, wogegen für das intakte Blatt mit Basisbestreichung der Bewegungswinkel −45.5° und das Wuchsstoffverhältnis Ad: Ab=63.7: 36.3 betrug. Diese Verhältnisse ergeben sich nach meiner Ansicht daraus, dass durch das Durchschneiden der inneren Rippen die Lieferung von Wuchsstoff—sowohl des natürlichen wie des zusätzlichen—von der Spitze nach der Abaxialseite des Stiels teilweise oder ganz unterbunden wird und damit die Abaxialseite von der Adaxialseite an Wuchsstoffgehalt übertroffen wird, da die Lieferung an die Adaxialseite durch die intakt gebliebenen äusseren Rippen fortdauert. Umgekehrt wird durch Durchschneiden der

äusseren Rippen bei Basisbestreichung wegen Unterbindung der Wuchsstofflieferung nach der Adaxialseite ein Überwiegen an Wuchsstoff in der Abaxialseite (bei Aufrichtung der Spreite) oder ein Ausgleich des Wuchsstoffgehalts beider Seiten (bei schwacher Senkung) bewirkt. Die oben angeführten Versuche des Rippendurchschneidens scheinen mir meine Auffassung der Bewegungen weiterhin zu erläutern und zu bestätigen. Jedenfalls haben sie mich davon überzeugt, dass für die Aufrichtung die Sendung von Wuchsstoff durch die inneren Rippen, und für die Senkung die Sendung durch die äusseren Rippen eine wesentliche Rolle spielt, indem der Wuchsstoff von der Spitze durch die inneren Rippen nach der Abaxialseite und von der Basis durch die äusseren Rippen nach der Adaxialseite des Stiels gesandt wird.

Viertens, konnte durch Kombinierung der Versuche mit Querzonenbeschattung und Durchschneiden der Rippen weiteres zu diesem Punkt festgestellt werden. Bei Basisbeschattung wurde nämlich die Senkung der Spreite durch Durchschneiden der äusseren Rippen merklich gestört und oft sogar eine wenn auch schwache Aufrichtung ausgelöst (Bewegungswinkel +8.5°, Ad: Ab=47.6: 52.4). Anderseits wurde bei der Spreite mit Spitzenverdunkelung durch Durchschneiden der inneren Rippen statt der Aufrichtung die Senkung hervorgerufen (Bewegungswinkel −23°, Ad: Ab =70: 30). Offenbar ist auch hier der Effekt des Durchschneidens bei den inneren Rippen entscheidender als bei den äusseren.

Fünftens und letztens wurden die von mir erzielten Ergebnisse weiter bestätigt durch die Wuchsstoffbestimmung in abgeschnittenen Blättern mit ungleichmässiger Beleuchtung in den Querzonen. Bei jungen, wachsenden Blättern, die von im Freien stehenden Pflanzen abgenommen und unter Schutz vor Austrocken von oben elektrisch beleuchtet wurden, ergab sich bei Beschattung der Spreite zur Hälfte von der Spitze oder der Basis her nach vierstündiger Beleuchtung unter 6000 Lux ungleichmässige Wuchsstoffverteilung im Stiel. Ad: Ab betrug im Fall der Spitzenbeschattung 40.4: 59.6, in dem der Basisbeschattung 60.0: 40.0. Die Resultate stimmten also mit denen der Versuche mit intakten und tatsächlich bewegten Blättern völlig überein, und damit wurde die Veränderung der Wuchsstoffverteilung im Stiel durch Querzonenbeschattung und damit die von mir gegebenene Erklärung der Bewegungen weiter bestätigt.

Nun muss ich noch auf die Erörterung der oben vorbehaltenen Problemen zurückkommen. Erstens beobachteten wir in Abschnitt 3 die Unregelmässigkeit der Bewegung infolge der Beschattung der Spitze der Spreite. Hierzu ist zu sagen, das dafür die Epinastie des Blattes infolge der Beschattung der ganzen Oberseite der Spreite verantwortlich ist. Warum? Die jungen Blätter, deren Spreite ganz beschattet wurde, senkten sich merklich (Fig. 9). Diese epinastische Bewegung, deren Mechanismus hier nicht berührt wird, muss aber durch teilweise Beseitigung

der Beschattung geschwächt werden. Wenn aber diese teilweise Beseitigung in der Längszone der Spreite stattfindet, dann muss die seitliche phototropische Bewegung vor sich gehen, und die epinastische Bewegung wird dadurch ersetzt. Wenn aber die Beseitigung in der Spitzenzone der Spreite erfolgt (und dies bedeutet nichts anders als die Basisbeschattung),

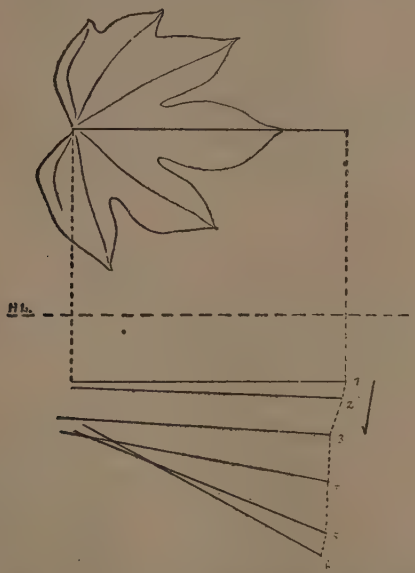

Fig. 9. Epinastische Bewegung der Blattspreite infolge Beschattung der gazen Oberseite der Spreite.

1. Anfangslage.
2. Lage nach 1 Tag.
3. „ „ 2 Tagen.
4. Lage nach 3 Tagen.
5. „ „ 4 Tagen.
6. „ „ 5 Tagen.

dann tritt Senkung der Spreite in der oben erwähnten Weise ein; die geschwächte Epinastie wird durch die phototropische Senkung unterstützt, und wir beobachten eine deutliche Senkung der Spreite. Die teilweise Epinastie und phototropische Senkung helfen einander, und die dabei beobachtete Bewegung ist also die Summe aus der geschwächten Epinastie und phototropischen Senkung (hierbei wird die geotropische Bewegung der Spreite nicht berücksichtigt, weil sie bei *Fatsia*-Blättern noch nicht genau untersucht). Bei der Beseitigung der Beschattung in der Basis der Spreite, nämlich bei Spitzenbeschattung, steht aber die Sache etwas anders, weil hier die Epinastie der Spreite, obwohl sie geschwächt ist, mit dem Vermögen der Aufrichtung zu kämpfen hat. Beide wiegen sich gegeneinander auf und das Defizit zwischen dem ver-

bleibenden epinastischen Vermögen und dem Aufrichtungvermögen wird in der dabei beobachteten Bewegung wirksam. Wenn das erstere stärker ist, dann wird die Senkung, wenn das letztere stärker ist die Aufrichtung hervorgerufen. Welches der beiden Vermögen dabei grösser ist, ist nicht a priori bestimmt, sondern je im einzelnen Blatt verschieden, da das Vermögen, Wuchsstoff zu liefern (und zwar sowohl zu produzieren als auch zu tranportieren), und das Reaktionsvermögen des Stiels einerseits und das Vermögen der Epinastie andererseits für jedes einzelne Blatt je nach Alter, Wachstumszustand, Blattform und sonstigen äusseren Bedingungen verschieden sind. Obwohl bei Spitzenbeschattung die Vorbedingungen für Aufrichtung der Spreite geschaffen sind, können sie durch Epinastie dieserart gestört werden, und daraus ergibt sich die offenbare Unregelmässigkeit in der Bewegungsweise.

Zweitens, erinnern wir uns an die Aufrichtung infolge Bestreichung der Basis mit Heteroauxin auf der Unterseite der Spreite. Hierbei muss berücksichtigt werden, dass die Rippen auf der Unterseite sehr stark hervortreten. Das ist vor allem bei den inneren Rippen, und ganz besonders bei der Mittelrippe der Fall, da sie viel dicker und grösser sind als die äusseren Rippen. Bei gleichmässiger Bestreichung der Unterseite der Basis muss demgemäss von den inneren Rippen selbst viel mehr Wuchsstoff direkt absorbiert und nach der Abaxialseite des Stiels gesandt werden und infolgedessen die Aufrichtung bewirken. Diese Erklärung wurde weiter durch die Senkung der Blätter bestätigt, wenn wir die Bestreichung der hervorspringenden inneren Rippen vermeiden und sie nur auf denjenigen parenchymatischen Teil beschränkten, in dem die äusseren Rippen verteilt sind. Die Senkung kann auch durch Durchschneiden der inneren Rippen unter gleichmässiger Basisbestreichung der Unterseite ausgelöst werden. In der Oberseite ist aber der Transport des Wuchsstoffes durch die inneren Rippen viel geringer als der durch die äusseren Rippen, weil die Rippen auf der Oberseite wenig hervorspringen, und da ausserdem der parenchymatische Teil, in dem die äusseren Rippen verteilt sind, viel grösser sind als derjenige, den die inneren Rippen durchlaufen. Infolgedessen wurde bei Basisbestreichung auf der Oberseite die Senkung, auf der Unterseite die Aufrichtung ausgelöst.

Bezüglich der Rippenversuche hat schon RAYDT in *Plectranthus* den Transport des Reizstoffes in den Rippen (nach RAYDT: Leitungsbahnen) anerkannt, da beim Durchschneiden der Mittelrippe keine Aufrichtung der Blätter mit verdunkelter Spitze erfolgt, doch leider hat er seine Versuche nicht weiter fortgeführt. Beim Abschneiden der Spitze der Spreite haben sich die Blätter von *Plectranthus* weder bei Oberlicht noch im Dunkeln, und daraus schliesst er die Unabhängigkeit der Bewegung vom Einfluss des Ausschaltens der Assimilation. Unter dem Gesichtspunkt der Erforschung der Reizleitung bleibt aber seine Darstellung unvollständig,

weil wir bei RAYDT keinen Aufschluss daüber erhalten, ob dabei die Blätter sich senken, und er nicht einmal das Abschneiden der Basis der Spreite und Durchschneiden der äusseren Rippen in seine Versuche einbezogen hat.

Nun glaube ich aus den oben angeführten Gründen auf die physiologische Gleichwertigkeit der hier beobachteten vertikalen Bewegungen der Blätter infolge der Querzonebeschattung einerseits und der seitlichen phototropischen Bewegung infolge der Längszonebeschattung anderseits fast sicher schliessen können, weil beide phototropische Wachstumsbewegungen sind, deren Bewegungsweise ganz auf der Wuchsstoffverteilung im Stiel beruht, indem der Lichtreiz auf der Lamina unter der Mitwirkung des Transportvermögens der Rippen durch Änderung der Wuchsstoffverteilung im Stiel die Bewegungen hervorruft.

8. Zusammenfassung

1. Durch teilweise Verdunkelung in der Querzone der Lamina von *Fatsia japonica* werden Bewegungen in vertikaler Richtung ausgelöst; die Verdunkelung der Spitze der Spreite führt zur Aufrichtung, die der Basis zur Senkung.

2. Bei der Aufrichtung wurde im Blattstiel mehr Wuchsstoff in der Abaxialseite gefunden (Ad: Ab=38.7: 61.3), dagegen bei der Senkung mehr in der Adaxialseite (Ad: Ab=63.9: 36.1).

3. Durch Bestreichung der Spitze der Spreite mit Heteroauxinpaste wurde die Aufrichtung des Blattes, dagegen durch die Basisbestreichung die Senkung ausgelöst. Im ersteren Fall wurde mehr Wuchsstoff in der Abaxialseite des Stiels (Ad: Ab=40.4: 59.6), im letzteren Fall mehr in der Adaxialseite gefunden (Ad: Ab=61.5: 39.5).

4. Das Durchschneiden der inneren Rippen führt zur Senkung, das der äusseren Rippen zur Aufrichtung von Stiel und Lamina. Dabei wurde in ersteren Fall mehr Wuchsstoff in der Adaxialseite (Ad: Ab=68.8: 31.2), im letzteren Fall mehr in der Abaxialseite des Stiels festgestellt (Ad: Ab =33.7: 66.3).

5. Partielle Abschneiden der Spreite in der Querzone löst gleichfalls vertikale Bewegung aus; das Spitzenabschneiden die Senkung (Ad: Ab =63.5: 36.5), das Basisabschneiden die Aufrichtung (Ad: Ab=35.0: 65.0).

6. Der Verlauf der Rippen wurde untersucht und festgestellt, dass die inneren Rippen, die bis zur Spitze der Spreite verlaufen, in die Abaxialseite, die äusseren Rippen, die in der Basis der Lamina verteilt sind, in die Adaxialseite des Stiels hineinmünden.

7. Hieraus ergab sich die Schlussfolgerung: die Aufrichtung wird ausgelöst durch verstärkte Sendung von Wuchsstoff durch die inneren

Rippen nach der Abaxialseite des Stiels infolge des erhöhten Wuchsstofflieferungsvermögens der verdunkelten Spitze; die Senkung wird ausgelöst durch verstärkte Sendung von Wuchsstoff durch die äusseren Rippen nach der Adaxialseite. Daraus lässt sich auch einwandfrei auf die physiologische Gleichwertigkeit der vertikalen Bewegungen mit den seitlichen phototropischen Bewegungen der Blätter schliessen, da in beiden die Bewegung vom Lichtreiz auf der Lamina beherrscht wird, der durch Veränderung der Wuchsstoffverteilung im Stiel unter Mitwirkung der Rippen wirksam wird.

* * * * *

Die vorliegende Arbeit wurde im Botanischen Institut der Universität zu Tokio unter der Anweisung von Herrn Prof. Dr. H. NAKANO von 1938 bis 1940 ausgeführt. Ich freue mich, meinem hochverehrten Lehrer meinen ergebensten Dank an dieser Ort aussprechen zu können.

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Erklärung der Tafel VIII

Fig. 1. Senkung und Aufrichtung der Spreite infolge Verdunkelung der Querzone der Spreite.
A. Senkung der Lamina infolge Basisbeschattung (siehe Vers. 6 in Tab. 3). Das rechte Blatt, die Kontrolle, erhält das Licht gleichmässig vom oben und infolgedessen nimmt es wagrechte Lage ein.
B. Aufrichtung der Lamina infolge Spitzenbeschattung (siehe Vers. 6 in Tab. 4). Das linke Blatt ist die Kontrolle.

Fig. 2. Aufrichtung und Senkung der Spreite infolge Heteroauxinbehandlung.
Links: Senkung der Spreite infolge Basisbestreichung (siehe Vers. 3 in Tab. 5).
Rechts: Aufrichtung der Spreite infolge Spitzenbestreichung (siehe Vers. 3 in Tab. 6).

Fig. 3. Aufrichtung der Lamina infolge teilweiser Bestreichung der Untersete der Lamina mit Heteroauxinpaste.
Rechts: Aufrichtung der Lamina infolge Spitzenbestreichung.
Mittel: Aufrichtung der Lamina infolge Basisbeschattung.
Links: Wagerechte Lage der Lamina des Kontrollblattes.

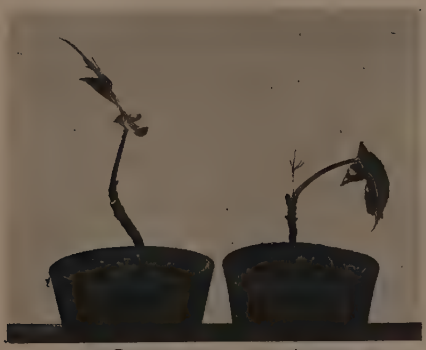
Fig. 4. Aufrichtung und Senkung der Blattspreite infolge teilweisen Durchschneidens der Rippen.
A. Senkung der Lamina infolge Durchschneidens der inneren Rippen (siehe Vers. 10 in Tab. 8).
B. Aufrichtung der Lamina infolge Durchschneidens der äusseren Rippen. (siehe Vers. 4 in Tab. 9).

A. B.

Fig. 1

Fig. 2

Fig. 3



B. A.

Fig. 4

Untersuchungen über den Ascorbinsäuregehalt verschiedener Apfelsorten[1]

Von Tomota SUGAWARA

Hierzu 1 Textfigur u. 4 Tabellen

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I. Einleitung

Die seit langem wohl bekannte antiskorbutische Wirkung von frischen grünen Gemüsen und einigen Obstsorten ist neuerdings auf die Gegenwart des Vitamin C, der l-Ascorbinsäure in denselben zurückgeführt worden. Die Bedeutung dieses Vitamins für den menschlichen Organismus gab den Anlass dazu, seine Verbreitung in vielen Pflanzen und auch in ihren Produkten zu untersuchen (11–15, 19–25, 28–33, 35–40). Nun während einige Forscher den Vitamin C-Gehalt des Apfels als gering oder sogar sehr gering bewerten, betrachten die anderen ihn als mehr oder minder reichlich oder sehr reichlich zu sein (3–9, 12, 14, 15, 17, 21–24, 27, 35). Im allgemeinen kann man wohl sagen, dass die bisherigen Untersuchungen noch nicht umfangreich genug waren, um darüber ein endgültiges Urteil gestatten zu können. Es ist das Ziel der vorliegeden Arbeit, eine möglichst umfassende Kenntnis über den Ascorbinsäuregehalt der japanischen Apfelsorten zu gewinnen, und darüber hinaus alle fassbaren Ursachen, die den Ascorbinsäuregehalt des Apfels nennenswerterweise beeinflussen können, zu studieren.

In der vorliegenden Arbeit, die zum Teil von der Praxis angeregt worden ist, möchte ich über die zonale Verteilung der Ascorbinsäure beim Apfel, über ihren Gehalt von verschiedengefärbten Sorten, sowie über die Veränderung des letzteren nach der Lagerungsweise einige Mitteilungen machen. Bei unserer Arbeit kam die titrimetrische Methode von TILLMANS, die die Ascorbinsäure in Extrakten quantitativ zu bestimmen und auch eine grosse Anzahl von Untersuchungen verhältnismüssig schnell durchzuführen gestattet, zur Anwendung.

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II. Material und Methode

(1) Material

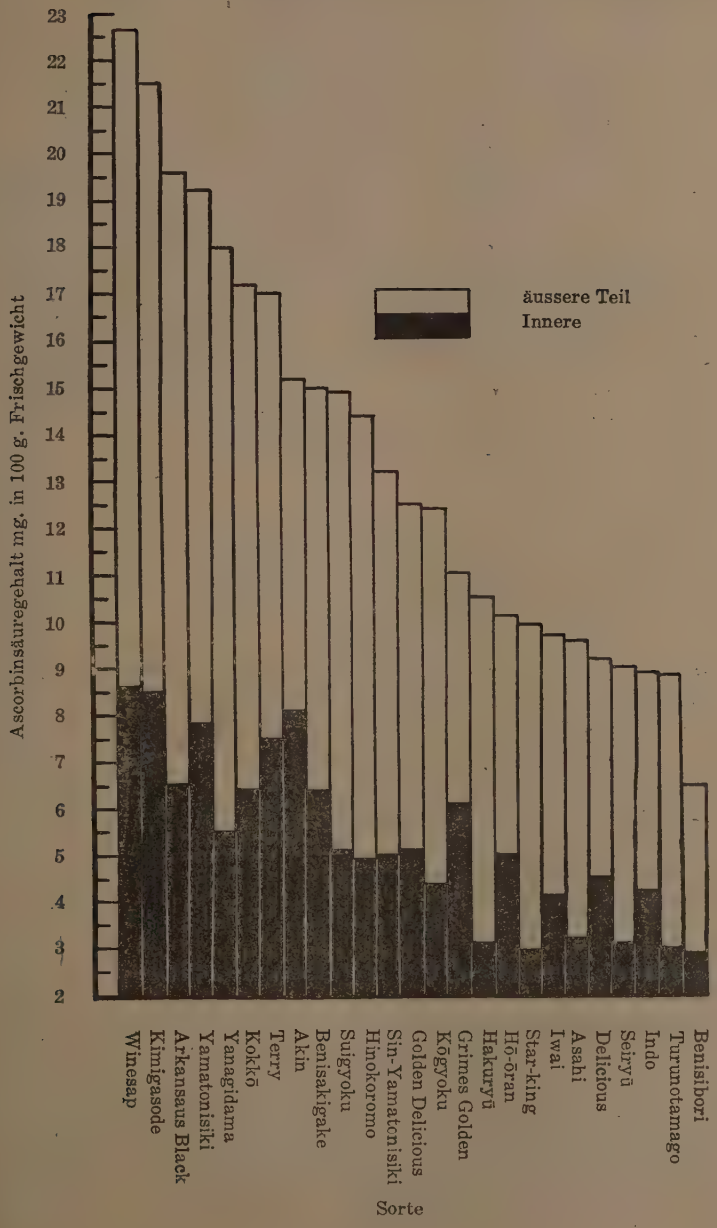
Als Forschungsmaterial dienten mir die 1940 geernteten Früchte von folgenden fünfundzwanzig Sorten Apfels, die aus Yamagata, Nagano, Aomori, und Sapporo abstammen, nämlich:

1. Akin (Akin, Akin Red)
2. Arkansas Black (Arkansas Black, Arkansas Black Twig)
3. Asahi (McIntosh Red)
4. Benisakigake (Red Astrachan, Abe Lincoln)
5. Benisibori (Fameuse, Chimney Apple)
6. Delicious (Delicious, Red Delicious)
7. Golden Delicious (Golden Delicious)
8. Grimes Golden (Grimes Golden)
9. Hakuryū (White Pearmain, White Winter Pearmain)
10. Hinokoromo (Tompkins King, King of Tompkin County)
11. Hō-ōran (Yellow Bellflower, Belle Flavoise)
12. Indo
13. Iwai (American Summer Pearmain, Watkins Early)
14. Kimigasode (Northern Spy, Spy)
15. Kōgyoku (Jonathan, Esopus Spitzenburg)
16. Kokkō (Ralls Janet, Ralls Genet)
17. Seiryū (White Pippin, Canada Pippin)
18. Sin-yamatonisiki (Black Ben Davis)
19. Starking (Starking)
20. Suigyoku (Yellow Newtown Pippin, Albemarle Pippin)
21. Terry (Terry)
22. Turunotamago (Ortley, Crane's Pippin)
23. Winesap (Winesap, Holland's Red Winter)
24. Yamatonisiki (Ben Davis, Baltimore Pippin)
25. Yanagidama (Smith Cider, Choice Kentuck).

(2) Methodik der Ascorbinsäurebestimmung

Für die Bestimmung der Ascorbinsäure bediente ich mich ausschliesslich der Titration-Methode nach TILLMANS (34), welche durch HARRIS und RAY (16), MACK und TRESSLER (18), FUJITA und EBIHARA (10) usw. verbessert wurde. Das Prinzip der Methode ist kurz wie folgt: Extraktion der Ascorbinsäure mit Säuremixtur (5% Metaphosphorsäure und 2-N Schwefelsäure) und Titration von Dichlorphenolindophenollösung mit diesem Extrakt. Die Einstellung der Farblösung erfolgte gegen reine Ascorbinsäure von MERCK, deren Reinheit jodometrisch nachgeprüft worden war.

Abb. 1. Abhängigkeit des Ascorbinsäuregehaltes von den Sorten.



Bei den meisten Analysen wurden die Proben aus je zwei Äpfeln entnommen. Das zu untersuchende Material wurde in zwei möglichst gleichen Hälften gesondert, von denen Portion 1 mit Schale versehen (äusserer Teil) und Portion 2 ohne solche (innerer Teil) war. Das Gesamtgewicht jeder Probe betrug 20 g, welche aus je zwei Äpfeln, und somit aus je 4 Sektoren von 5 g zusammengesetzt ist. Die Apfelscheiben wurden im Mörser mit Quarzsand genügend überschüttet und möglichst rasch in Säuremixtur zerdrückt und sehr fein zerrieben. Das ganze wurde zentrifugiert und das Zentrifugat nach Abgiessen der überstehenden Flüssigkeit wurde 2–3 mal an der Zentrifuge mit Säuremixtur ausgewaschen. Von der vereinigten und mit Säuremixtur auf ein bestimmtes Volumen gebrachten Flüssigkeit wurde ein gewisser Anteil mit Dichlorphenolindophenollösung titriert. Je nach dem Ascorbinsäuregehalt des Extraktes wurden entweder 2 oder 4 ccm. Indophenollösung 40 mg (100 ccm) vorgelegt und dann möglichst rasch titriert. Die Ascorbinsäurewerte werden in Milligram angegeben und beziehen sich auf 100 g Apfelscheiben.

III. Experimentelle Ergebnisse

(1) Untersuchungen über den Ascorbinsäure-Gehalt verschiedener Apfelsorten

Die in Tab. 1 angezeigten Ergebnisse der Untersuchungen werden eine Übersicht über das Vorkommen der Ascorbinsäure bei einer Reihe von Äpfeln geben, und zwar auch bei einigen Äpfeln, die in dieser Hinsicht bisher noch nicht untersucht worden sind. Bei einigen Äpfeln sind nebenbei die Ergebnisse anderer Forscher angeführt (17). Der Anteil des äusseren Teiles (d. h. mit Schale) am Ascorbinsäuregesamtgehalt jeder Frucht beträgt rund 70% (s. Tab. I), und man kann den hohen Wert, wie 22.65 mg finden. Beachtenswert ist dabei, dass dies Verhältnis auch bei Sorten deren absoluter Ascorbinsäuregehalt stark voneinander unterscheidet, wie Winesap und Benisibori, fast derselbe ist. KESSLER gibt an für deutsche Apfelsorten einen Schalenanteil an Vitamin C-Gehalt, der erheblich grösser ist (etwa 20%).

Aus den untersuchten Sorten lässt sich eine Reihe von ununterbrochen abnehmendem Ascorbinsäuregehalt bilden. Der Vitamin C-Gehalt erweist sich als eine fest erblich bedingte Sorteneigentümlichkeit. Die Ascorbinsäurewerte der versuchten Sorten stehen wie folgt: sehr reichlich, wie Winesap, Kimigasode, Yamatonisiki; reichlich, wie Arkansas Black, Terry, Kokkō; ziemlich reichlich, wie Akin, Benisakigake, Yanagidama; arm, wie Seiryū, Turunotamago, Benisibori.

TABELLE 1. Ascorbinsäuregehalt verschiedener Äpfelsorten.

Sorte	Zeit der Ernte	Frischgewicht der Frucht (g)	mg. Ascorbinsäure/100 g. Frischgewicht		
			ausser Teil (mit Schale)	innerer Teil	Mittelwert
Akin	25.10	275.0	15.27	8.08	11.67
Arkansas Black	1.11	165.3	19.59	6.50	13.04
Asahi	5. 9	294.5	9.68	3.20	6.44
Benisakigake	20. 8	202.0	15.00	6.43	10.71
Benisibori	14.10	210.0	6.54	2.95	4.74
Delicious	17.10	368.4	9.23	4.58	6.90
Golden Delicious	21.10	320.6	12.50	5.18	8.84
Grimes Golden	20.10	154.0	11.04	6.16	8.60
Hakuryū	25.10	295.2	10.50	3.11	6.80
Hinokoromo	15.11	340.0	14.42	4.95	9.68
Hō-ōran	25.10	275.3	10.16	5.00	7.58
Indo	8.11	270.5	8 90	4.24	6.57
Iwai	10. 9	183.6	9.73	4.15	6.94
Kimigasode	10.11	226.5	21.59	8.50	15.04
Kōgyoku	20.10	195.4	12.48	4.39	8.43
Kokkō	15.11	172.3	17.20	6.43	11.81
Seiryū	25.10	346.0	9.00	3.16	6.08
Sin-yamatonisiki	20.10	245.2	13.25	5.00	9.12
Star-king	20.10	293.0	9.95	2.96	6.45
Suigyoku	28.10	240.0	14.96	5.18	10.07
Terry	31.10	155.3	17.00	7.56	12.28
Turunotamago	15.10	238.0	8.90	3.00	5.95
Winesap	10.11	175.6	22.65	8.60	15.62
Yamatonisiki	20.10	212.2	19.26	7.85	13.55
Yanagidama	20.10	230.0	18.00	5.52	11.76

(2) Der Einfluss des Lichtes auf den Ascorbinsäuregehalt in Frucht

Bisher wurde vielfach die Frage aufgeworfen worden, in welcher Beziehung die Ascorbinsäuresynthese der Pflanzen zu dem Licht steht. In mehreren Untersuchungen haben wir auch schon die Abhängigkeit der Ascorbinsäure von diesem Faktor wahrscheinlich gemacht. Es wurde jedoch nur die natürlichen Bedingungen geprüft, wobei die Pflanzen im Freien stehen. Experimentelle Untersuchungen sollen nun einen weiteren Beitrag zu diesem Thema geben. Es interessiert dabei die Frage, wie gross die Menge der Ascorbinsäure in Äpfeln und einzelnen Fruchtteilen bei verringerter Lichteinwirkung sein wird.

Zur Prüfung dieser Verhältnisse wurden 20 g des roten und 20 g des grünen Teiles einer Frucht vergleichend analysiert. Überprüfen wir in diesem Zusammenhang die in Tab. 2 enthaltenen Werte, so ergibt der Vergleich zwischen grünem und rotem Teile des Apfels stets einen Mehr-

TABELLE 2. Gehalt an Ascorbinsäure von rotem und grünem Teil des Apfels.

Sorte	mg. Ascorbinsäure/100 g. Frischgewicht			
	rote Seite		grüne Seite	
	äusserer Teil	innerer Teil	äusserer Teil	innerer Teil
	14.08	4.95	11.11	4.24
	11.16	4.24	10.16	4.15
Kōgyoku	15.00	5.00	11.04	3.50
	14.42	5.18	10.50	4.24
	14.96	4.15	9.73	4.24
Mittel	13.92	4.70	10.50	4.07
	19.26	8.08	17.00	7.56
	19.59	9.16	15.27	7.00
Winesap	20.00	8.50	16.00	6.43
	17.20	9.68	16.25	8.00
	18.00	8.90	17.39	7.43
Mittel	18.81	8.86	16.38	7.28
	19.64	7.56	17.20	6.43
	21.59	8.50	16.13	5.18
Yamatonisiki	20.50	7.85	17.00	5.52
	18.00	6.54	16.48	4.58
	21.73	8.90	15.95	5.50
Mittel	20.29	7.87	16.55	5.44
	17.20	5.18	14.42	4.15
	20.00	5.00	13.25	4.39
Yanagidama	19.64	6.43	14.96	4.43
	19.50	5.52	14.25	3.50
	19.78	4.90	13.97	3.16
Mittel	19.22	5.40	14.17	3.92

gehalt an Ascorbinsäure bei dem roten Teile und zwar ist der rote Teil des Yanagidama in dieser Hinsicht am meisten begünstigt (30% mehr als der grüne Teil). Auch bei dem inneren Teil der nichtgefärbten Portion, fanden wir inbezug auf den Ascorbinsäuregehalt keinen besonderen Unterschied gegenüber demselben der gefärbten.

Neben dieser Verschiedenheit im Ascorbinsäuregehalt desselben Apfels in dem roten und grünen Teile, deren Färbungsunterschied ohne Zweifel durch die Verschiedenheit der Belichtung bedingt wurde und welcher häufig höchst bemerkbar ist, besteht noch ein beträchtlicher Unterschied hinsichtlich dem Ascorbinsäuregehalt nach dem Lichtgenuss. Der letztere macht sich bei den obengenannten Sorten äusserlich in einer mehr oder minder starken Färbung der Früchte bemerkbar, sodass man bei diesen Sorten aus ihrem Färbungsverhältnis der Früchte umgekehrt auf ihren Lichtgenuss schliessen kann.

Dass doch die Farbe nicht immer für den Ascorbinsäuregehalt das Entscheidende sein kann, zeigen weiter die Untersuchungen der rein zitronengelben Früchte von Golden Delicious, einer an Ascorbinsäure reichsten Apfelsorte, deren Individuen trotz ihrem gleichen Aussehen starke Verschiedenheiten in Vitamin C-Gehalt aufweisen. Andererseits enthält Benisibori, ein gleichmässig dunkelroter Apfel, nur eine sehr geringe Menge Ascorbinsäure.

(3) Abhängigkeit des Ascorbinsäuregehaltes von der Herkunft der Sorte

Obschon beim Apfel der Gehalt an Ascorbinsäure als ein wichtiger Merkmal betrachtet werden muss, sind bisher, wie schon eingangs erwähnt, diese Eigenschaft bei verschieden Sorten recht uneinheitlich beurteilt worden, sodass die im folgenden beschriebenen Untersuchungen auf möglichst breiter Grundlage durchgeführt wurden. Es wurden nämlich alle verfügbaren Sorten verschiedener Herkünfte einbezogen, von denen mindestens je drei Früchte für jede Sorte gebraucht wurden.

In Tabelle 3 sind die Früchte verschiedener Herkünfte nochmals besonders zusammengestellt, wonach man klar erkennen kann, dass der Ascorbinsäuregehalt einer und derselben Sorte recht beträchtlich von ihrem Standort abhängt. Besonders ausgeprägt ist es bei den Sorten, wie Yamatonisiki und Kokkō. Anderseits zeigen die Sorten, wie Hakuryū weniger starke Abweichungen in dieser Hinsicht. Wie weit hier die Besonnung dafür verantwortlich sein kann, oder ob dabei irgend eine andere klimatische und Bodenverschiedenheit eine wesentliche Rolle spielen mag, muss noch dahingestellt bleiben. Jedenfalls lässt die Vergleichung der Ascorbinsäurewerte und Sonnenscheindauer keine eindeutige Behiezung erkennen, also müssen auch noch die anderen Bedingungen eine Rolle gespielt haben. Anderseits erweist sich der Ascorbinsäuregehalt als eine feste Sorteneigentümlichkeit, so z. B. ist der hohe Ascorbinsäuregehalt der Früchte von Winesap, Kokkō, und Yamatonisiki allgemein bekannt.

TABELLE 3. Abhängigkeit des Ascorbinsäuregehalts von Herkunft einer Sorte.

Sorte	Herkunft	Frischgewicht einer Frucht (g) Mittel	mg. Ascorbinsäure / 100 g. Frischgewicht	
			äusserer Teil	innerer Teil
Akin	Aomori	296.3	16.26	6.93
	Sapporo	138.5	12.58	7.00
	Yamagata	275.0	15.27	8.08
Benisibori	Sapporo	130.0	8.63	3.17
	Yamagata	210.0	6.54	2.95
Delicious	Aomori	365.5	11.19	4.70
	Iwate	358.6	9.50	5.27
	Nagano	360.2	10.00	4.95
	Sapporo	225.0	8.50	4.39
	Yamagata	368.4	9.23	4.58
Golden Delicious	Aomori	302.6	12.50	4.65
	Iwate	352.4	11.78	6.78
	Nagano	371.5	11.08	5.09
	Sapporo	255.0	9.30	3.56
	Yamagata	320.6	12.50	5.18
Hakuryū	Aomori	290.0	11.04	4.52
	Nagano	370.6	8.87	4.09
	Sapporo	195.4	9.50	3.15
	Yamagata	295.2	10.50	3.11
Hō-ōran	Sapporo	238.0	11.87	4.94
	Yamagata	275.3	10.60	5.00
Indo	Aomori	293.0	11.87	4.91
	Iwate	265.4	12.18	5.33
	Nagano	273.6	7.42	3.51
	Sapporo	295.2	5.70	3.27
	Yamagata	270.5	8.90	4.24
Kōgyoku	Aomori	170.2	12.50	3.65
		205.0	9.16	4.28
	Nagano	179 5	11.30	4.39
	Sapporo	173.0	13.96	4.53
	Yamagata	195.4	12.48	4.39

Tabelle 3. (Fortsetzung).

Sorte	Herkunft	Frischgewicht einer Frucht (?) Mittel	mg. Ascorbinsäure / 100 g. Frischgewicht	
			äusserer Teil	innerer Teil
Kokkō	Aomori	250.0	16.96	6.33
	Iwate	182.5	19.79	6.08
	Nagano	240.2	20.65	8.48
	Sapporo	152.3	16.90	5.58
	Taikyū	146.6	13.97	5.93
	Tinnanpo	195.5	14.39	6.59
	Yamagata	172.3	17.20	6.43
Seiryū	Aomori	370.2	10.55	4.39
	Sapporo	210.5	7.79	3.00
	Yamagata	346.0	9.00	3.16
Starking	Aomori	295.5	7.85	2.89
	Sapporo	294.0	11.50	3.39
	Yamagata	175.0	8.05	2.96
Winesap	Aomori	200.0	19.79	8.00
	Sapporo	78.5	22.61	9.00
	Yamagata	175.6	22.65	8.60
Yamatonisiki	Aomori	290.4	17.96	5.10
	Nagano	160.0	19.00	7.61
	Sapporo	205.2	12.96	3.65
	Yamagata	212.2	19.26	7.85
Yanagidama	Aomori	245.0	19.00	5.79
	Sapporo	182.5	15.83	6.33
	Yamagata	230.0	18.00	5.52

(4) Veränderungen des Ascorbinsäuregehaltes bei der Lagerung des Apfels

Zehn Sorten wurden ausgewählt, nämlich Delicious, Golden Delicious, Indo, Kōgyoku, Kokkō, Sin-yamatonisiki, Starking, Winesap, Yamatonisiki, und Yanagidama. Die Äpfel wurden sorgfältig ausgesucht, um den Faulverlust auf dem Lager möglichst zu vermeinden. Es wurde immer darauf besonders bestrebt, die möglichst gleichmässigen, dem durchschnittlichen Typus entsprechenden Früchte zu bekommen. Da die Äpfel bei etwa 3–4°C oder etwa 11–13°C bis zu 150 Tagen in einwandfreiem Zustande gelagert werden können, habe ich die Veränderung des Ascorbinsäuregehaltes während dieser Lagerungsdauer bestimmt. Alle Tage

geschah zum gleichen Zeitpunkt die Prüfung verschiedener Proben. Untersucht wurden je 10 Äpfel, bei deren Auswahl alle Färbungsgrade berücksichtigt wurden.

TABELLE 4. Veränderung des Ascorbinsäuregehalts von Apfel bei der Lagerung.

Sorte	Tagezahl der Lagerungsdauer		Ascorbinsäuregehalt in mg./100 g. Apfel bei			
			Beginn	50	100	150
Delicious	Normal-lagerung[1]	a. T.[3]	9.50	9.30	8.48	9.00
		In.[4]	5.27	4.09	3.97	3.65
	Kühl-lagerung[2]	a. T.		9.46	9.30	8.05
		In.		5.10	4.52	4.30
Golden Delicious	Normal-lagerung	a. T.	11.87	10.55	10.60	10.37
		In.	6.78	6.25	5.18	5.14
	Kühl-lagerung	a. T.		11.30	11.08	10.96
		In.		6.43	6.21	5.76
Indo	Normal-lagerung	a. T.	7.42	7.15	6.84	6.84
		In.	4.25	4.16	3.93	3.65
	Kühl-lagerung	a. T.		7.25	6.95	6.95
		In.		4.20	4.16	4.16
Kōgyoku	Normal-lagerung	a. T.	11.30	11.00	8.60	8.78
		In.	4.39	4.15	3.24	2.93
	Kühl-lagerung	a. T.		11.30	11.11	10.96
		In.		4.25	4.30	4.00
Kokkō	Normal-lagerung	a. T.	16.98	14.39	14.62	13.50
		In.	7.00	6.50	5.93	5.18
	Kühl-lagerung	a. T.		15.83	15.00	14.26
		In.		6.78	6.54	6.33
Sin-yamatonisiki	Normal-lagerung	a. T.	12.50	11.87	10.50	8.60
		In.	4.95	3.80	3.11	2.10
	Kühl-lagerung	a. T.		12.50	12.18	11.87
		In.		4.91	4.52	4.30
Starking	Normal-lagerung	a. T.	10.60	10.55	8.96	9.18
		In.	2.89	2.67	2.50	2.45
	Kühl-lagerung	a. T.		10.60	10.45	10.34
		In.		2.86	2.70	2.50
Winesap	Normal-lagerung	a. T.	20.65	19.16	18.00	16.96
		In.	8.96	8.48	7.42	6.33
	Kühl-lagerung	a. T.		19.79	19.00	18.32
		In.		8.90	8.63	7.25

TABELLE 4. (Fortsetzung).

Sorte	der Tagezahl Lagerungsdauer		Ascorbinsäuregehalt in mg./100 g. Apfel bei			
			Beginn	50	100	150
Yamatonisiki	Normal-lagerung	a. T.	16.96	15.27	15.00	14.39
		In.	6.93	5.70	4.97	3.54
	Kühl-lagerung	a. T.		16.64	16.25	15.42
		In.		6.15	6.08	5.65
Yanagidama	Normal-lagerung	a. T.	17.20	16.00	14.87	15.10
		In.	5.52	4.31	4.06	3.65
	Kühl-lagerung	a. T.		17.13	17.05	17.00
		In.		5.41	5.35	4.96

(1) Normallagerung (11—13°C) (2) Kühllagerung (3—4°C)
(3) a. T.—äussere Teil (4) In.—Innere

Das Ergebnis der Analysenwerte ist in Tab. 4 zusammengestellt.

11–13°: bei dieser verhaltnismässig hohen Temperatur haben schon vom 150-ten Tage an die gelagerten Früchte an ihrem äusseren Teil eine beträchtliche Menge Wassers verloren, und auch ihre Haut ist welk, sodass die Endwerte in der Tabelle zu hoch sein müssen, denn sie beziehen sich auf das Frischgewicht zu dem gegebenen Zeitpunkt. Die Früchte haben an Vitamin C nach 100 Tagen 10–25%, nach 150 Tagen etwa 15–50% ihres anfänglichen Gehaltes verloren.

3– bis 4°: Die Früchte haben ein sehr gutes Aussehen, waren fest und noch etwas rötlich gefärbt. Der Gewichtsverlust war trotz der hohen Luftfeuchtigkeit sehr beträchtlich, d. h. 5–10% nach 100 Tagen und 10–15% nach 150 Tagen. Im allgemeinen ergibt sich, dass bei normaler Lagerung ein Schwund der Ascorbinsäure in den Äpfeln stattfindet, während bei der Kühllagerung sie in hoher Masse erhalten bleibt.

IV. Allgemeine Betrachtungen

Der Ascorbinsäuregehalt ist nicht nur in verschiedenen Apfelsorten, sondern auch in den einzelnen Geweben und Teilen einer und derselben Frucht äusserst verschieden; ausserdem erfährt er nach dem Unterschied der Lagerungszustände weitgehende Veränderungen. Vor kurzem veröffentlichte KESSLER (17) seine Angaben über den Vitamin C-Gehalt einer grosse Anzahl von deutschen Apfelsorten. Aus den von ihm untersuchten Sorten lässt sich eine ununterbrochene Reihe von allmählich abnehmendem Ascorbinsäuregehalt bilden.

Durch titrimetrische Bestimmungen konnten wir die Ergebnisse des Tierfütterungsversuches von ZILVA und anderen bestätigen und erweitern. Demnach ist die Ascorbinsäure-Konzentration, auf Frischgewicht bezogen, in den Schalen viel höher als im Fleisch, doch ist dieselbe eines ganzen Apfels viel höher als dieselbe der ganzen Schale, weil die letztere gewichtsmässig nur einen geringen Teil des ganzen Apfels ausmacht. Z. B. PAECH (21) bemerkt, dass die Schalen von 3 Wiltshire-Äpfeln zusammen rund 10 mg Ascorbinsäure und ihr Fleisch insgesamt 25 mg enthielten; ob die Verteilung der Ascorbinsäure unter Zugrundelegung eines anderen Bezugspunktes, z. B. des Trockengewichtes, eine gleichmässigere ist, muss noch untersucht werden. KESSLER (7) gibt allerdings an für Boskoop und andere Sorten einen Schalenanteil an Ascorbinsäuregehalt, der erheblich grösser ist (etwa 20%). Bei unseren Versuchen wurde es auch festgestellt, dass die Ascorbinsäure-Konzentration im Aussenteil viel höher ist als im Inneren.

Eine betrachtliche Versuchiedenheit im Ascorbinsäuregehalt jeder Sorte kann durch den Unterschied des Standortes der Früchte bedingt werden. Jedoch hat man bisher diese wichtige Tatsache bei den Bestimmungen des Ascorbinsäuregehaltes japanischer Apfelsorten nicht berücksichtigt. So z. B. für gewisse Sorten, je nach ihrem respektiven Herkunft, hat sich ein sehr verschiedener Ascorbinsäuregehalt ergeben: bei Yamatonisiki, Kokkō und Winesap kann er bei einigen Individuen bis zum doppelten oder mehrfachen der anderen steigen, obschon bei den Sorten, wie Kōgyoku und Indo er anscheinend nur innerhalbe enger Grenzen schwanken wird. Schon KESSLER (17) hat als wirksame Faktoren, welche den Ascorbinsäuregehalt des Apfels beeinflussen können, den Lichtgenuss, die Herkunft, die Ertragsgrösse und die Düngung erkannt. Wie oben gezeigt, hängt der Ascorbinsäuregehalt einer Sorte recht beträchtlich von ihrem Standort ab, was bei Sorten, deren Früchte äusserlich je nach der Herkunft stark variieren, besonders ausgeprägt ist. Eine Vergleichung zwischen dem Ascorbinsäurewert einer und derselben Sorte von verschiedenen Produktionsgebieten und der an diesen respektiven Orten gemessenen Sonnenscheindauer lassen keine eindeutige Beziehung zwischen beiden erkennen, also kann die Besonnung allein keineswegs für den starken Unterschied des Ascorbinsäuregehaltes bei den Früchten verschiedener Herkünften verantwortlich zu sein gedacht werden. Es wäre daher erwünscht sein, auch die anderen äusseren Faktoren, wie Temperatur, Bodenfeuchtigkeit, Nährstoffverhältnisse und physikalisch-chemischen Bodenzustand in bezug auf ihrer Wirksamkeit näher zu prüfer (17, 19, 20, 21, 28–32, 36).

Rotbäckige Apfel zeigt auf dem kräftig gefärbten Teile einen höheren Ascorbinsäuregehalt als auf dem blassen. Andererseits ist es aber zu bemerken, dass der Vitamin C-Gehalt der Apfelschale keineswegs in einem

direkten Verhältnis zu ihrer roten Farbe steht, so z. B. hat die Sorte, welche durch den reichsten Ascorbinsäuregehalt ausgezeichnet ist, wie Golden Delicious, eine allseitig gelbgefärbte Schale, während die sehr kräftig rotgefärbte Sorte, wie Benisibori, nur einen mässigen Ascorbinsäuregehalt aufweist. Bei Äpfeln mit gleichmässig gefärbter Schale lässt sich dort auch eine gewisse Abstufung des Vitamin C-Gehaltes erkennen obwohl die Abweichungen nicht so gross wie bei den rotgrüngefärbten sind, wo der rote Schalenteil mehr als die doppelte Menge Vitamin C als der grüne enthalten kann, was übrigens schon von PAECH (21) und KESSLER (17) nachdrücklich hingewiesen worden war.

Im allgemeinen kann man sagen, dass bei der normalen Lagerung (11–13°) des Apfels ein Schwund an Ascorbinsäure stattfindet, während bei der Kühllagerung (3–4°) der Ascorbinsäurevorrat in hoher Masse erhalten bleibt. Offenbar bei höheren Temperaturen werden die Ascorbinsäuren für die Atmung oder anderen Stoffwechselorgänge verbraucht (17, 33), wogegen bei der Herabsetzung ihrer Geschwindigkeit durch niedere Temperaturen dieser Abbau zum Stillstand kommen wird.

V. Zusammenfassung

1. Die Ascorbinsäure-Bestimmung verschiedener Apfelsorten wurde nach der von HARRIS und RAY (1933) verbesserten Methode von TILLMANS (1930) ausgeführt. Für den Analysengang wurden einige Verbesserungen vorgenommen.

2. Der Ascorbinsäurewert der wichtigsten Sorten steht wie folgt: sehr reichlich (Winesap, Kimigasode, Yamatonisiki, Arkansas Black), reichlich (Kokkō, Terry, Akin, Benisakigake), ziemlich reichlich (Suigyoku, Hinokoromo, Sin-yamatonisiki, Golden Delicious) und arm (Asahi, Seiryū, Turunotamago, Benisibori).

3. Im äusseren Teil des Apfels, einschliesslich der Schale beträgt der Gesamtgehalt der Ascorbinsäure rund 70% und der hohe Wert, wie 22.65 mg wurde bisweilen aufgefunden.

4. Der rote Teil enthält mehr Ascorbinsäure als der grüne desselben Apfels, und bei dem inneren Fleische, welches überhaupt nicht gefärbt ist, ist den ganzen Teil hindurch keiner Unterschied des Ascorbinsäuregehaltes zu erkennen.

5. Der Ascorbinsäuregehalt einer und derselben Sorte hängt beträchtlich von Standortverhaltnissen ab. Besonders ausgeprägt ist diese Tatsache bei den Sorten, deren Früchte in ihrem Aussehen je nach Herkunft stark variieren.

6. Bei der normalen Lagerung (11 bis 13°) der Früchte findet der Schwund der Ascorbinsäure statt, während bei der Kühllagerung (3 bis 4°) der Vitaminvorrat in hoher Masse erhalten bleibt.

An dieser Stelle erlaube ich mir, Herrn Professor Dr. NOGUTI, meinem hochverehrten Lehrer, für die mir jederzeit erteilten wertvollen Ratschläge meinen herzlichsten Dank auszusprechen.

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Studies on the formation of ascorbic acid (vitamin C) in plants

4. Daily variation of ascorbic acid content and the concentration of carbohydrate in the leaves of plants

By Tomota SUGAWARA

With 5 text-figures and 5 tables

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Introduction

In connection with the investigation on the formation of ascorbic acid in plant, an opportunity was afforded to study the relation between the diurnal changes of ascorbic acid contents and the accumulation of carbohydrates in the leaves. In the previous paper (16), the author has reported the fact that the close correlation exists between the amount of ascorbic acid and the apparent photosynthesis. Further, it was stated that the ascorbic acid is synthesized from the photosynthetic products, such as hexose in plants.

Since the hexose may be regarded as the first stable product of photosynthesis, it was thought to be likely that the diurnal change of ascorbic acid contents will depend on the amount of carbohydrates in the leaves. The present investigation is concerned with the diurnal fluctuation of the concentration of ascorbic acid and the accumulation of carbohydrates in leaves.

Material and methods

Five species used in this experiment were *Spinacia oleracea* var. Japanese, *Triticum sativum* L. var. Saitama No. 27, *Hordeum vulgare* L. var. Torano-o, *Vicia Faba* L. var. Wasesoramame, and *Brassica pekinensis* RUPR. var. Chihli Pe-tsai. The plants were grown under field conditions, and the samples were collected at certain definite periods. The

technique employed in sampling the plant is that formerly described by the author (16). The variation of temperature in air was automatically recorded during these tests, and the solar radiation on a horizontal surface was also measured by means of a ROBITZ's bimetal actinograph. Both the ascorbic acid and carbohydrate were estimated according to the method which has been outlined in the previous paper (16).

Experimental results

1. Diurnal changes of ascorbic acid contents of leaves in clear days

Spinach, of which seeds were sown in last October, was used in this test, and samples were taken for chemical analysis in the various experiments at the two hours' interval. The tests were conducted from the last days of March to the beginning of April, when the spinach was beginning to bolt and was about 20 cm. high. The results are given in table 1 and figure 1, which correspond somewhat to the typical case.

In general, the concentration of ascorbic acid of the blade is low in the morning and maximum from 1:30 p.m. to 3:30 p.m., whereafter it begins to diminish slowly. The accumulation of carbohydrates shows a similar trend, i.e. the time of the greatest accumulation of photosynthetic products corresponds to that of the highest concentration of ascorbic acid in the leaves. There was very little difference throughout the three days of experimentation, as far as the temperature and solar radiation are concerned. It may be seen that the meteorological conditions when these experiments were carried out, were favorable for the assimilation of carbon dioxide.

Another experiment was conducted in order to determine, whether the above fact may be true for some other plants. The comparison was made concerning the daily variation of ascorbic acid in the leaves of a few kinds of plants grown under natural conditions, for which cf. table 2. The results also show that there is a marked difference in concentration of ascorbic acid in blade between morning and afternoon, and the concentration reaches the maximum in the afternoon. Leaves of wheat which were studied show almost always higher concentration than in all other plants (figure 2). It is interesting to see that the diurnal fluctuation of ascorbic acid contents in various plants is quite similar, and suggests the possibility that light might act to synthesize the carbohydrates into ascorbic acids.

In some experiments with spinach grown under field conditions in summer season, in which plants similar in age as those used in spring were tested, and a diurnal change of ascorbic acid contents was also found

TABLE 1. Diurnal changes of ascorbic acid contents in leaves of spinach in clear days

	Date	A.M. 5:30	7:30	9:30	11:30	P.M. 1:30	3:30	5:30	7:30	9:30	11:30	A.M. 1:30	3:30
Ascorbic acid (mg./g.)	24-25/III	2.205	2 240	2.395	2.482	2 540	3.100	2.889	2.800	2.620	2.543	2.400	2.320
	25-26/III	2.117	2.000	2.250	2.374	2.392	2.960	3.000	2.950	2.540	2.310	2.225	2.208
	1-2/IV	2.369	2.480	2.524	2.700	3.015	3.120	3.015	2.880	2.656	2.450	2.390	2.258
Dry matter Per	24-25/III	44.00	45.82	46.25	48.23	51.00	55.06	54.76	52.14	51.00	49 17	48.20	45.53
M^2 leaf area (g.)	25-26/III	43.50	45.56	46.30	47.25	49.16	52.00	49.24	48.00	46.20	45.82	44.00	42.68
	1-2/IV	45.15	46.20	47.96	50.05	53.15	52.44	53.02	51.60	49.84	48.20	46.75	46.19
Acid hydrolyzable	24-25/III	7.32	7.60	8.05	8.93	10.16	10.79	11.00	10.65	10.00	9.21	8.54	7.67
Carbohydrate Per	25-26/III	6.80	7.15	7.52	8.30	9.21	10.65	10.05	9.78	9.21	8.93	8.00	7.10
M^2 leaf area (g.)	1-2/IV	7.10	7.52	8.00	9.35	11.25	11.60	11.00	10.39	10.05	8.30	7.95	6.80
Temperature (C)	24-25/III	4.5	6.0	12.0	17.0	19.0	20.5	19.0	16.0	12.0	10.0	8.0	5.5
	25-23/III	5.0	5.5	13.0	21.5	24.0	25.0	20.0	16.5	15.0	13.0	11.5	8.0
	1-2/IV	2.0	3.0	11.5	16.5	17.5	17.0	15.5	14.0	8.0	6.5	4.0	1.5
Solar radiation	24/III	—	0.4	1.1	1.4	1.4	0.9	0.1	—	—	—	—	—
gm.-cal./cm^2. min.	25/III	—	0.5	0.9	1.2	1.3	1.0	0.3	—	—	—	—	—
	1/IV	—	0.7	1.1	1.3	1.2	1.0	0.2	—	—	—	—	—

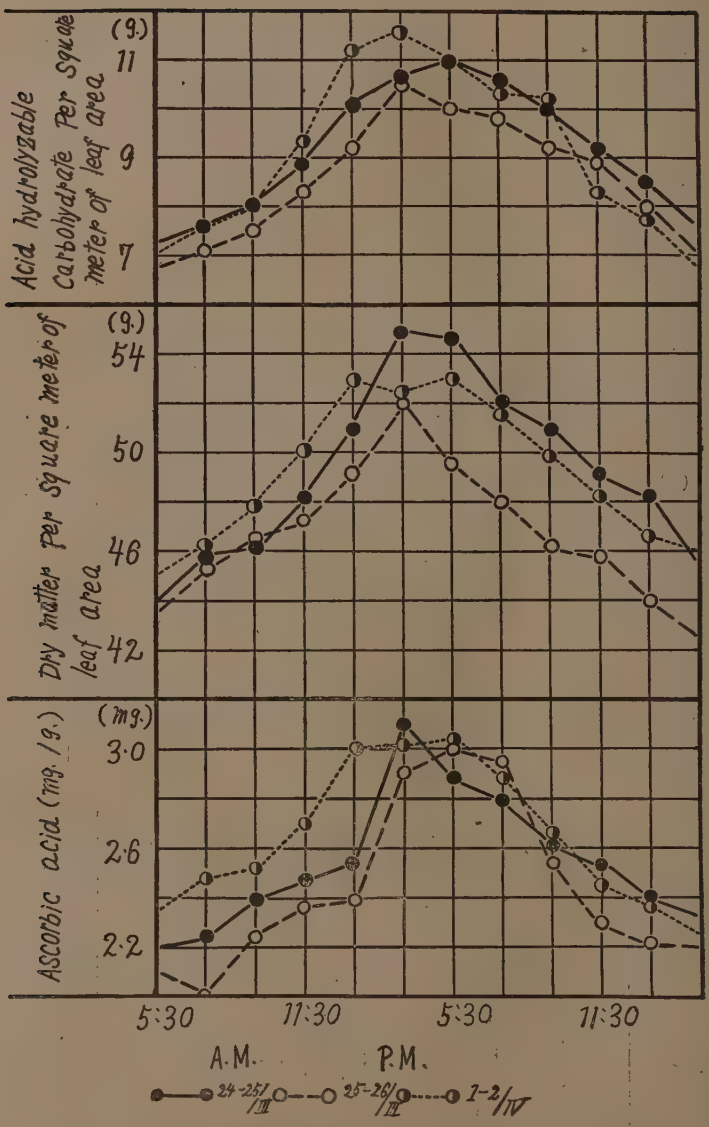

Fig. 1. Diurnal changes of ascorbic acid contents in leaves of spinach in clear days.

TABLE 2. Daily variation of concentration of ascorbic acids in plants.

	Plants	A.M. 5	7	9	11	P.M. 1	3	5	7	9	11	A.M. 1	3
Ascorbic acid (mg./g.)	Barley	1.950	2.057	2.100	2.245	2.330	2.450	2.565	2.420	2.400	2.366	2.102	2.005
	Broad bean	2.105	2.300	2.562	2.684	2.765	2.600	2.741	2.515	2.473	2.240	2.005	1.986
	Chinese cabbage	1.850	1.864	1.890	1.999	2.117	2.200	2.105	2.005	1.999	1.916	1.916	1.713
	Wheat	2.117	2.200	2.416	2.684	2.765	2.950	2.720	2.684	2.600	2.515	2.200	2.205
Acid hydrolyzable carbohydrate	Barley	8.10	8.16	8.30	9.54	11.12	12.40	12.56	12.00	11.95	10.71	9.45	8.30
	Broad bean	7.60	7.67	7.95	8.34	9.78	10.65	10.05	10.39	10.24	10.00	9.36	8.73
	Chinese cabbge	7.32	7.15	7.95	8.30	9.21	9.78	10.00	9.78	9.50	9.27	8.93	8.54
	Wheat	8.96	9.50	10.15	11.40	13.04	13.17	13.17	13.05	12.95	12.24	11.12	10.15
Temperature (C)		9.0	12.0	15.0	25.0	25.5	24.0	21.0	17.5	15.0	11.0	11.0	10.5
Solar radition gm.-cal./cm^2. min.		—	0.1	0.7	1.4	1.4	1.0	0.3	—	—	—	—	—

during this period, for the concentration of ascorbic acid in blade increases parallel to an increase in photosynthetic products (table 3 and figure 3). At that time, the decrease of ascorbic acid concentration in afternoon towards the night was slightly more rapid than in the spring season, and

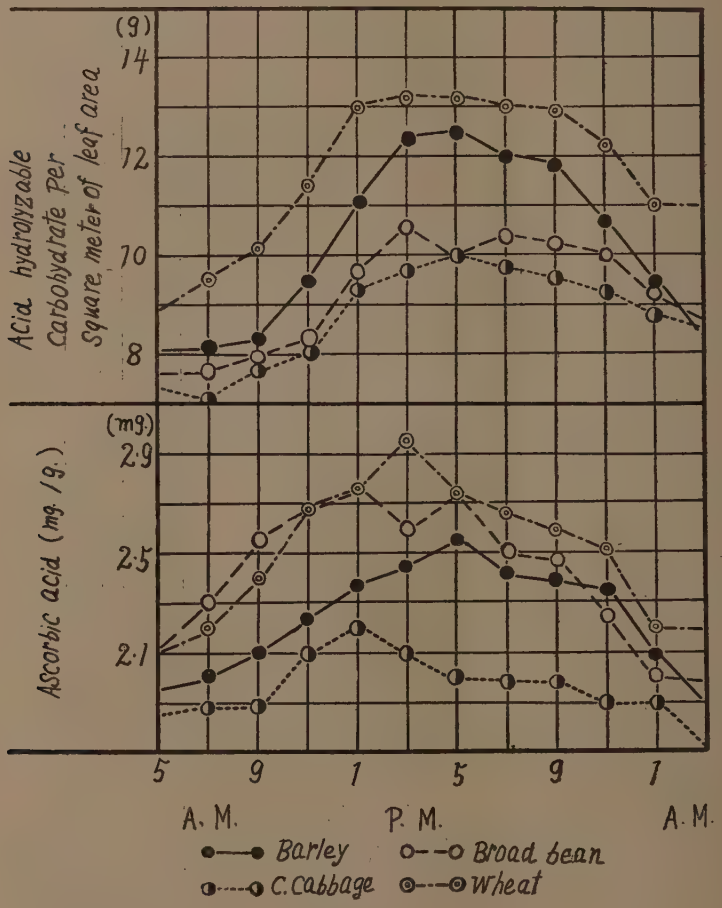

Fig. 2. Daily variation of concentration of ascorbic acid in plants.

that differences in the concentration of blade at night of two season were attributable to the difference of night temperature. In general, the ascorbic acid content of spinach in the spring was considerably higher than that in summer.

TABLE 3. Daily variation of ascorbic acid contents in spinach in clear days of summer season.

	Date	A.M. 5:30	7:30	9:30	11:30	P.M. 1:30	3:30	5:30	7:30	9:30	11:30	A.M. 1:30	3:30
Ascorbic acid (mg./g.)	23-24/VI	1.420	1.662	1.999	2.124	2.000	2.200	2.117	1.986	1.713	1.624	1.456	1.330
	5-6/VII	1.576	1.700	2.005	2.208	2.392	2.250	2.000	2.005	1.986	1.927	1.792	1.504
Acid hydrolyzable carbohydrate Per M^2 leaf area	23-24/VI	6.95	7.26	7.93	8.81	10.65	11.00	10.32	10.05	10.00	9.78	8.40	7.10
	5-6/VII	7.35	7.35	8.02	8.96	11.25	11.14	10.65	10.73	10.48	10.32	9.14	7.26
Solar radiation	23-24/VI	0.1	0.6	1.0	1.3	1.5	1.1	0.4	—	—	—	—	—
gm.-cal./cm^2 min.	5-6/VII	0.2	0.7	1.2	1.4	1.5	1.2	0.6	—	—	—	—	—
Temperature (C)	23-24/VI	21.0	25.5	27.0	27.5	28.0	27.5	26.5	24.5	24.0	23.5	23.0	22.0
	5-6/VII	24.0	26.0	29.0	30.5	31.0	31.0	29.5	28.0	27.5	26.0	25.0	23.0

2. Diurnal changes of ascorbic acid contents of leaves of rainy days

In the above experiment, the results show that there is a close relationship between the diurnal change of ascorbic acid contents and the concentration of carbohydrates, because the decrease of the accumulation of carbohydrate is associated with that of ascorbic acid content. This seems to be associated in its turn mainly with carbon dioxide assimilation,

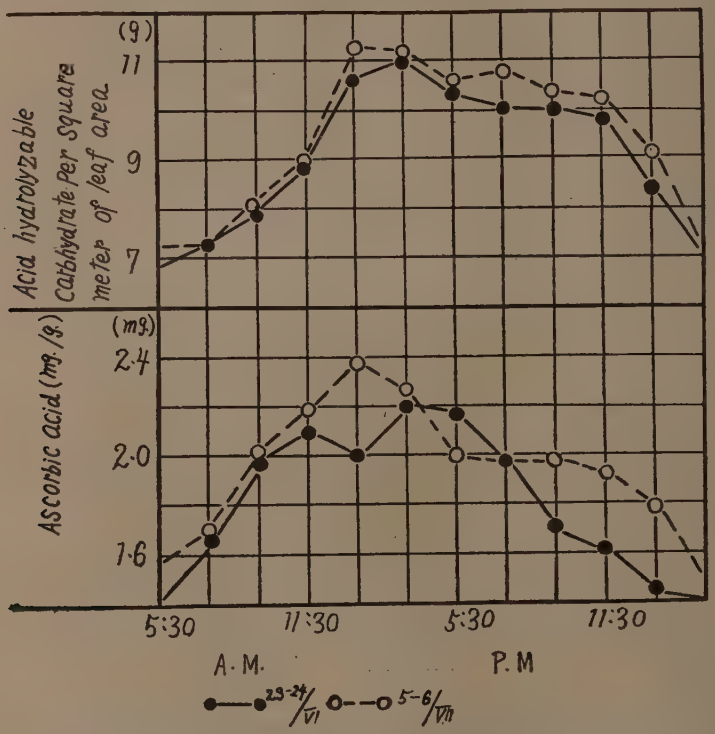

Fig. 3. Daily variation of ascorbic acid contents in spinach in clear days of summer season.

although the influence of other factors might not be entirely excluded. The experiment was therefore done to study the diurnal fluctuation of concentration of ascorbic acid in leaves under rainy weather, which is unfavorable for the assimilation of carbon dioxide by plants. Spinachs which have grown on field were used as materials in this experiment and the results are given in table 4.

It is clear from the above results that the concentration of ascorbic acid in leaves did not increase in the day time and the daily variation of ascorbic acid contents was very irregular in rainy weather (figure 4).

TABLE 4. Diurnal changes of ascorbic acid contents in leaves of spinach in rainy days.

	Date	A.M. 5:30	8:30	11:30	P.M. 2:30	5:30	8:30	11:30	A.M. 2:30
Ascorbic acid (mg./g.)	7–8/III	2.250	2.104	2.150	2.150	2.062	2.106	2.000	1.987
	14–15/III	2.124	2.100	2.321	2.005	2.392	2.113	2.100	2.100
	18–19/III	2.258	2.113	2.374	2.392	2.398	2.374	2.250	2.005
Temperature (C)	7–8/III	6.0	6.0	9.5	14.0	12.0	9.0	8.5	7.5
	14–15/III	4.5	3.5	7.0	12.5	11.0	10.5	9.0	8.0
	18–18/III	4.0	4.0	7.5	9.5	8.0	7.0	5.0	4.5

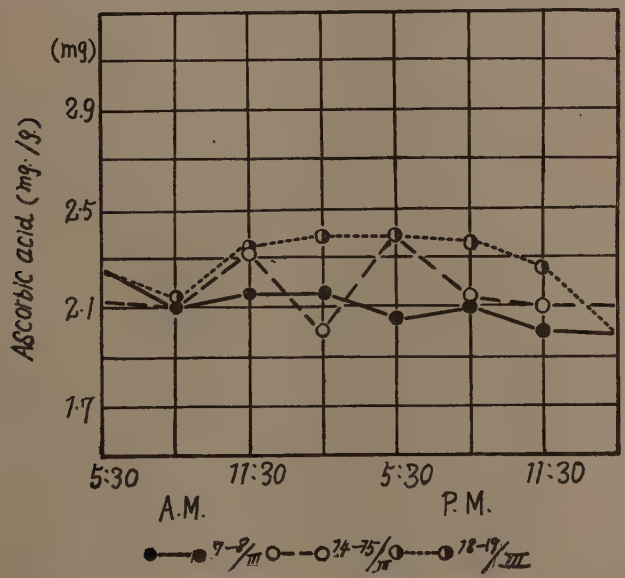

Fig. 4. Diurnal changes of ascorbic acid contents in leaves of spinach in rainy days.

On the other hand, the amount of ascorbic acid of leaves in rainy weather was much less than that in clear weather and this amount was almost equal at different times of one day. From these results, it may certainly be seen that the diurnal fluctuation of ascorbic acid content in leaves will depend upon the photosynthetic products in plants.

3. Effect of carbon dioxide concentration in the air on the amount of ascorbic acid in plants

TABLE 5. Effect of carbon dioxide concentration in the air on the amount of ascorbic acid in spinach.

CO_2 %	0.035	0.065	0.095	0.125	0.155	0.215	0.275	0.365
Ascorbic acid (mg./g.)	2.760	2.900	3.062	3.218	3.360	3.450	3.471	3.500
Acid hydrolyzable carbohydrate per m^2 leaf area (g)	10.16	12.35	14.12	14.68	15.02	15.30	15.75	16.12

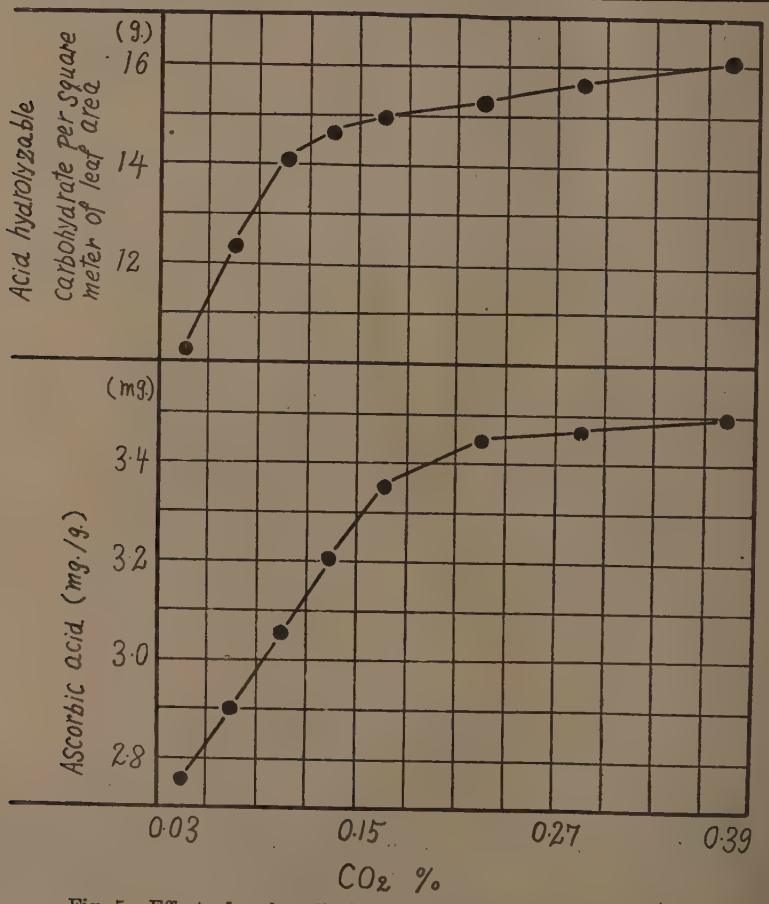

Fig. 5. Effect of carbon dioxide concentration in the air on the amount of ascorbic acid in spinach.

Preliminary tests showed that the concentration of carbon dioxide had an important effect on the ascorbic acid contents and tests were conducted in fine days of last of March. The source of light employed was direct sunlight between 11:00 a.m. and 2:00 p.m., and the carbon dioxide concentration was varied from 0.03 to 0.365 per cent. The results which correspond to the typical case are given in table 5. The amount of ascorbic acid may be changed by means of an external supply of carbon dioxide. The data indicated that an increase in carbon dioxide concentration above the normal (0.035 per cent) results in an increased ascorbic acid content, also that with increasing carbon dioxide concentration the augmentation of the quantity of ascorbic acid is high at first and gradually becomes less (figure 5). The amount of ascorbic acid is almost directly proportional to the carbon dioxide concentration up to 2 to 5 times of its normal concentration in air, though still higher concentration leads but to very slight increase.

Discussion

A comparison of text-figures 1 and 3 with 4 shows that the amount of ascorbic acid in the leaves fluctuates considerably during the day. Under fair weather condition which is favorable for the formation of ascorbic acid in plants it is high, while under rainy weather condition its amount in leaves remained almost unchanged during the whole day, and it is much less than in clear day. The data also show that the time of highest concentration of ascorbic acid corresponds to that of the greatest accumulation of carbohydrates in the leaves.

On the other hand, it has already been noted that the carbohydrate, such as glucose, can be converted into ascorbic acid by seedlings in the process of germination. An investigation (REID, 1938) on etiolated seedlings of cowpea plants proved that the amount of ascorbic acid increases, when additional carbohydrate is supplied to them in the form of glucose. According to MOLDTMANN (11), a correlation exists between the amount of ascorbic acid and glucose content in some monocotyledonous plants. Recently, WEISSENBÖCK (20) advanced the view that the amount of glucose in plants is most important factor for the formation of ascorbic acid. In the previous experiment (16), the author found that the amount of ascorbic acid in leaves was particularly high under the high activity of photosynthesis, but an increase in ascorbic acid content was also found in etiolated seedlings when they were cultivated on sugar medium in darkness. From the results of these experiments, he stated that the ascorbic acid is synthesized from photosynthetic products, such as hexose. In all, it may certainly be concluded that the diurnal changes of ascorbic acid

contents in leaves are closely connected with the daily variation of amounts of carbohydrates, such as sugars in plants.

It has been generally considered that the light intensity, the amount of chlorophyl, and the concentration of carbon dioxide in air are most important factors for the photosynthetic activities.

On the other hand, MOLDTMANN (11), NEUBAUER (12), WEBER (17, 18, 19), and the author (16) observed that the above factors are very effective for the formation of ascorbic acid in plants. So that the close connection existing between the assimilation of carbon dioxide and the synthesis of ascorbic acid was ascertained in these experiments: the direct relationship exists between the photosynthesis and the formation of ascorbic acid, but the ascorbic acid is not the first product of the photosynthesis. In general, the ascorbic acid is synthesized in the process of germination under the dark conditions, and on the other hand, an increase in ascorbic acid content was found in etiolated seedlings through external supply of soluble carbohydrates as glucose and fructose. From the above facts, it is clear that among the internal factors, which have influences upon the formation of ascorbic acid in the leaves, the concentration of carbohydrates, such as hexose is most effective under natural conditions. It may therefore be stated that the ascorbic acid in leaves is a secondary product of the photosynthesis in plants.

Summary

(1) Data on the diurnal changes of concentration of ascorbic acid in leaves are presented which were based on the experiments of spinach, barley, wheat, broad bean, and Chinese cabbage during the summer of 1940 and the spring of 1941.

(2) The concentration of ascorbic acid in the leaves fluctuates considerably during fine day, and is in maximum in the afternoon from 1:30 p.m. to 3:30 p.m.; it is on the average much greater in spinach in spring than that in summer.

(3) Daily variation of ascorbic acid in leaves shows a similar trend with the amount of carbohydrate changes, i.e. the greatest accumulation of ascorbic acid agrees in respect to the time with the highest concentration of carbohydrates in the leaves.

(4) In rainy weather, the ascorbic acid content of leaves did not increase in the day time, and it remains almost unchanged at different times of one day. In such weather, the amount of ascorbic acid in leaves was much less than in fine weather.

(5) An increase in carbon dioxide concentration above that in normal air leads to the increase of the ascorbic acid content, and the

amount of ascorbic acid is almost directly proportional to the carbon dioxide concentration of air within the limit of our experiments.

The author wishes to express his thanks to Prof. Y. NOGUTI for his kindness in suggesting this problem, as well as in preparation of the paper. The expenses in connection with this work were defrayed from the grant given by the Hattori Hôkôkai, to the council of which the writer wishes to acknowledge his indebtedness.

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Influence of physical and chemical factors upon the formation of appressoria in the conidia of *Piricularia Oryzae*

II. Influence of temperature [1]

By Hashio SUZUKI

With plates IX—XI, 7 text-figures, and 6 tables

(Received July 7, 1941)

Contents

I. Introduction

It has been confirmed by the writer (7, 8, 9, 12, 13) that certain chemical and physical factors affect appressorium formation in the conidia of *Piricularia Oryzae* Br. et Cav., which is closely related to the entrance of the fungus into the host plant of rice. A number of studies (2, 5, 6) have been made on the relation of temperature to germination of the conidia of this fungus. Sueda (6) has published the results of his extensive and valuable studies on this subject.

So far as the writer is aware, there has been no particular investigation on the effect of temperature on appressorium formation in the conidia of *P. Oryzae*, the minimum, optimum, and maximum temperatures for appressorium formation being yet undetermined. Sueda (6), who was the first to study the relation of temperature to appressorium formation, con-

(1) This investigation was assisted in part by a grant from the Imperial Academy, to which the writer here records his grateful thanks.

cluded from experiments conducted by the hanging drop culture method that the fungus conidia, when allowed to remain for 24 hours at 25°C, produced more appressoria than those maintained at 17° or 30°C for the same number of hours. Using the same method, ITO and KURIBAYASI (2) found that small numbers of appressoria are formed in the fungus conidia at temperature fluctuating from 15° to 18°C, but rarely appear at 25°C. They also pointed out that, at 18° and 28°C, the fungus conidia require an incubation period between six and ten hours to produce appressoria on the leaf of the rice plant, and that after an incubation period of 24 or 48 hours, appressorium formation for the conidia occurs in a greater rate on the host plant at 18° than at 28°C.

The writer also studied the effects of various temperatures on the germination and formation of appressoria in the conidia of *P. Oryzae*. The abstract of this investigation, of which details are here mentioned, has already been reported (13). The results in connexion with the relation of various incubation periods to germination and to appressorium formation are also described in this paper.

II. Relation of temperature to appresorium formation

Three strains of the fungus, I, II, and III, all of which were isolated from the interior of rice seeds and cultured through a single spore isolation, were used in all the experiments. In the previous paper (8), only str. I was examined. The conidia for examination were obtained from cultures of the three strains grown on potato agar with one per cent saccharose at 25°C for from two to three weeks.

1. Effect of temperature on appressorium formation in one per cent glucose solution

The method of this experiment is identical with that described in the previous paper (8). A glucose solution (1 gm of glucose and 100 cc of distilled water), and a number of PETRI dishes, in the bottoms of which two pieces of cellophane, each about two square cm, were placed, were prepared and the whole was sterilized by the ordinary method. In order to supply a sufficient moisture, and to prevent change of the concentration of the solution in which the conidia were suspended, about 10 cc of the one per cent glucose solution were slowly introduced into the bottom of each PETRI dish, and small pieces of cellophane, each with a drop of the spore suspension placed in the center of its surface, were allowed to float on the surface of the solution.

The whole was then kept for a certain hours in the thermostats adjusted to the following temperatures: 10°, 15°, 20°, 25°, 30°, 32.5°, 35°, and 40°C. At the end of incubation periods of 15, 24, and 48 hours,

the number of conidia that germinated and the number of appressoria that were formed on the ends of the germ tubes grown from the conidia were counted under a microscope.

The results obtained from the experiments at the end of 15 hours of incubation are shown in Table 1 and Fig. 1.

TABLE 1. Germination and appressorium formation in the conidia of *P. Oryzae* in one per cent glucose solution at various temperatures after incubation for 15 hours.

Number of strain	Temperature °C	Number of conidia tested (A)	Germination of conidia		Formation of appressoria	
			Number of germinated conidia counted (B)	Per cent (B/A)	Number of appressoria counted (C)	Per cent (C/A)
I	10	750	4	0.53	0	0
	15	800	195	24.38	0	0
	20	800	792	99.00	346	43.25
	25	750	746	99.47	412	54.93
	30	750	745	99.33	420	56.00
	32.5	750	742	98.93	296	39.47
	35	750	245	32.67	0	0
	40	700	0	0	0	0
II	10	500	0	0	0	0
	15	750	332	44.27	0	0
	20	800	657	82.13	244	30.50
	25	750	741	98.80	450	60.00
	30	800	788	98.50	475	59.38
	32.5	800	773	96.63	406	50.75
	35	700	356	50.86	0	0
	40	600	0	0	0	0
III	10	500	42	8.40	0	0
	15	850	622	73.18	0	0
	20	800	786	98.25	0	0
	25	800	792	99.00	0	0
	30	750	744	99.20	0	0
	32.5	800	788	98.50	0	0
	35	700	602	86.00	0	0
	40	600	0	0	0	0

It will be seen from Table 1 and Fig. 1, that after 15 hours of incubation, conidial germination in strains I and III takes place between 10° and 35°C, and that in str. II between 15° and 35°C (Plate X, Figs. 1–4).

At 10°C, the proportion of conidial germination is still very low for both strs. I and III, the proportion being only 0.53 per cent for str. I and 8.4 per cent for str. III. Conidial germination rapidly increases in each strain at 15°C, being 73.18 per cent for str. III, 44.27 per cent for str. II, and 24.38 per cent for str. I. Conidial germination is almost in the same proportion for all the strains at 15° and 35°C, the proportion of it at the both temperatures being very much lower than that at 25°, 30°, and 32.5°C.

From the results obtained at the end of 15 hours' incubation, it is difficult to determine clearly the optimum temperature for conidial germination of each strain, for the reason that conidial germination showed not

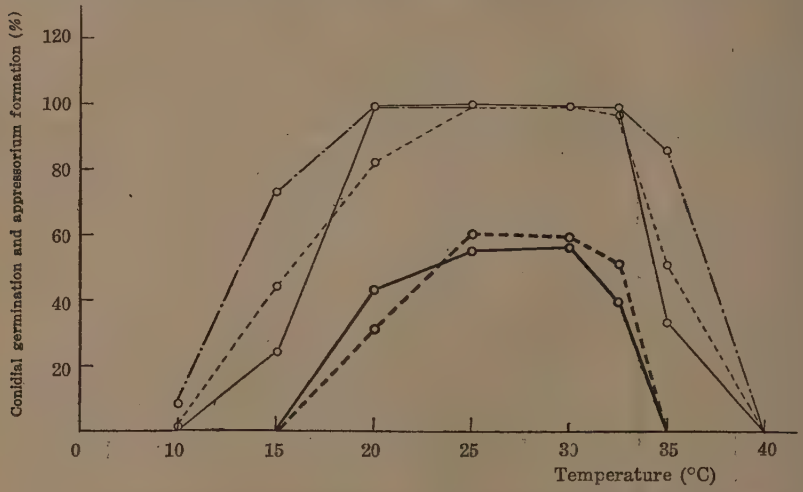

Fig. 1. Germination and appressorium formation in the conidia of *P. Oryzae* grown in one per cent glucose solution for 15 hours at different temperatures.

Conidial germination { Str. I ——— Str. II - - - - - - - - Str. III —— - ——
Appressorium formation { Str. I ——— Str. II - - - - - - - -

only very similar proportions at each temperature between 20° and 32.5°C, but also because the range of temperature at which the highest proportion of conidial germination was observed, widened with increase of incubation period, as will be shown in Tables 2 and 3. However, it may safely be said that, at the end of this incubation period, the optimum temperature for conidial germination for all the strains lies in the vicinity of either 25° or 30°C.

As to appressorium formation after an incubation period of 15 hours, compared with conidial germination, it occurs within a narrower range of temperature for conidia of strs. I and II. Moreover, an interesting fact is that, at every temperature examined, no appressorium was formed in

str. III. After germination, and under the conditions just mentioned, this strain continued only as mycelial growth.

At the end of 15 hours' incubation, appressorium formation takes place between 20° and 32.5°C in strs. I and II, the optimum temperature

TABLE 2. Germination and appressorium formation in the conidia of *P. Oryzae* in one per cent glucose solution at various temperatures after incubation for 24 hours.

Number of strain	Temperature °C	Number of conidia tested (A)	Germination of conidia		Formation of appressoria	
			Number of germinated conidia counted (B)	Per cent (B/A)	Number of appressoria counted (C)	Per cent (C/A)
I	10	700	15	2.14	0	0
	15	800	752	94.00	318	39.75
	20	750	744	99.20	725	96.67
	25	800	795	99.38	814	101.75*
	30	800	798	99.75	805	100.63*
	32.5	800	792	99.00	724	90.50
	35	800	793	99.13	0	0
	40	700	0	0	0	0
II	10	800	5	0.63	0	0
	15	800	724	90.50	324	40.50
	20	800	794	99.25	706	88.25
	25	800	798	99.75	804	100.50*
	30	750	748	99.73	732	97.60
	32.5	750	741	98.80	556	74.13
	35	800	702	87.75	0	0
	40	500	0	0	0	0
III	10	700	405	57.86	0	0
	15	800	792	99.00	0	0
	20	600	596	99.33	0	0
	25	750	746	99.47	0	0
	30	800	798	99.75	0	0
	32.5	750	747	99.60	0	0
	35	800	794	99.25	0	0
	40	750	0	0	0	0

* Two appressoria were sometimes formed either on each end of the two germ tubes grown from a spore or on each end of the two branches of a germ tube.

lying in the vicinity of either 25° or 30°C. Near the optimum temperature, the proportion of appressorium formation is still low, the proportion

being about 55 per cent for str. I and about 60 per cent for str. II.

Table 2 and Fig. 2 show the results of experiments after incubation for 24 hours.

As will be seen from Table 2 and Fig. 2, at each of the temperatures examined, the number of germinated conidia for each strain evidently increases more at the end of 24 hours than at the end of 15 hours. In strs. I and II, the increase is considerable at 15° and 35°C, and in str. III at 10°, 15°, and 35°C. Conidial germination in the three strains occurs

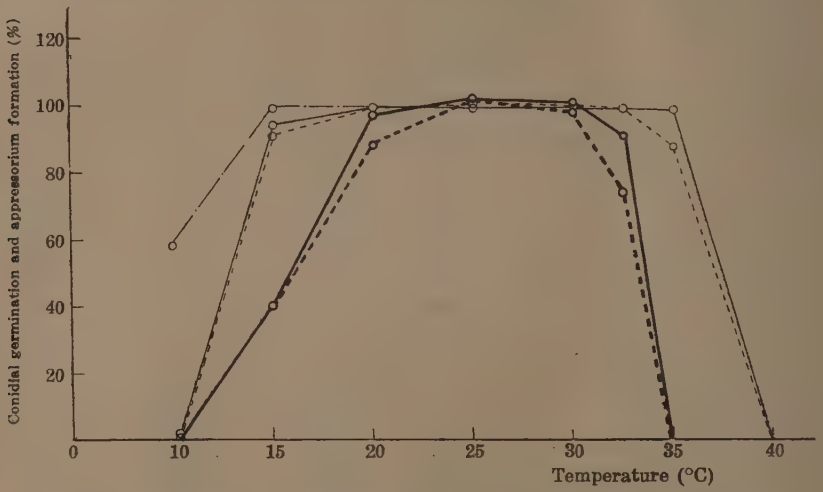

Fig. 2. Germination and appressorium formation in the conidia of *P. Oryzae* grown in one per cent glucose solution for 24 hours at different temperatures.

Conidial germination { Str. I ——— Str. II - - - - - - - - Str. III —— - ——

Appressorium formation { Str. I ——— Str. II - - - - - - - -

at the temperatures ranging from 10° to 35°C, the proportion of conidial germination at 25° and 30°C almost corresponding to that at 20°, 32.5°, and 35°C, and showing about 100 per cent. The proportion of germinated conidia at 10°C, which suddenly drops, when compared with that at 15°C, is highest for str. III, being 57.86 per cent, and it is very much low for the other two strains, being 2.14 per cent for str. I and 0.63 per cent for str. II. There is a sharp drop in the percentage of conidial germination, that is, at 35°C, about 99 per cent of the conidia germinate in strs. I and III, and about 90 per cent of those in str. II, whereas, at 40°C, a temperature higher by 5°C, no germination occurs in any of the strains.

After incubation of 24 hours, appressorium formation takes place in the conidia of strs. I and II at the temperatures ranging from 15° to

32.5°C, but not in those of str. III at any temperatures examined. Maximum appressorium formation in strs. I and II occurs between 20° and 32.5°C. Near the optimum temperature, the proportion of appressorium formation attains above 100 per cent, for the reason that two

TABLE 3. Germination and appressorium formation in the conidia of *P. Oryzae* in one per cent glucose solution at various temperatures after incubation for 48 hours.

Number of strain	Temperature °C	Number of conidia tested (A)	Germination of conidia		Formation of appressoria	
			Number of germinated conidia counted (B)	Per cent (B/A)	Number of appressoria counted (C)	Per cent (C/A)
I	10	650	272	41.85	0	0
	15	850	845	99.41	324	38.12
	20	800	785	98.13	764	95.50
	25	800	795	99.38	862	107.75
	30	800	782	97.75	858	107.25
	32.5	800	784	98.00	746	93.25
	35	800	758	94.75	0	0
	40	700	0	0	0	0
II	10	500	175	35.00	0	0
	15	750	742	98.93	325	43.33
	20	800	788	98.50	695	86.88
	25	800	793	99.13	818	102.25
	30	750	742	98.93	798	106.40
	32.5	800	782	97.75	741	92.63
	35	750	740	98.67	16	2.13
	40	500	0	0	0	0
III	10	500	322	64.40	0	0
	15	650	646	99.38	0	0
	20	600	598	99.67	0	0
	25	750	748	99.73	0	0
	30	600	596	99.33	0	0
	32.5	600	594	99.00	0	0
	35	700	679	97.00	0	0
	40	600	0	0	0	0

appressoria were sometimes formed either on each end of the two germ tubes that grew from a spore or on each end of the two branches of a germ tube; the former case being sometimes recognized in the conidia of

strs. I and II, and the latter in those of str. II. Both above and below optimum temperature, there is a gradual decrease in the proportion of appressoria formed in the two strains, while no appressorium formation occurs at 10° and 35°C.

The results of counting the number of conidia that germinated and the number of appressoria that were formed at the end of 48 hours of incubation are summarized in Table 3 and Fig. 3.

It will be seen from Table 3 and Fig. 3, that conidial germination in the three strains is very high, about 100 per cent, at each of the temperatures between 15° and 32.5°C, after 48 hours' incubation, as in the

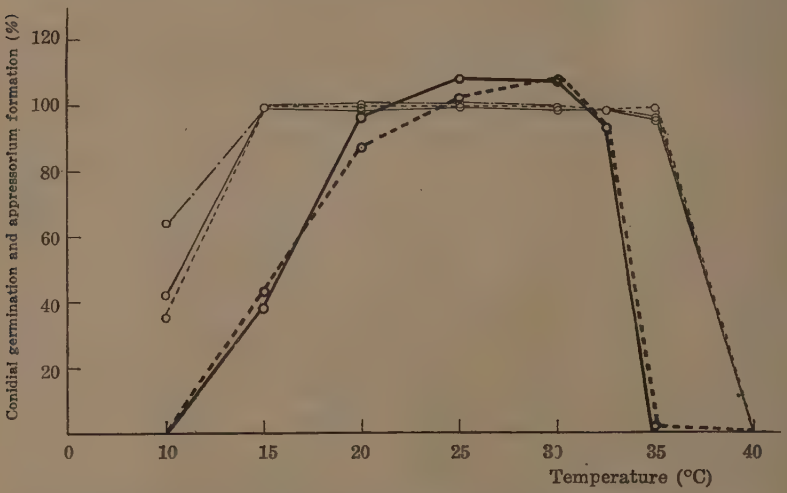

Fig. 3. Germination and appressorium formation in the conidia of *P. Oryzae* grown in one per cent glucose solution for 48 hours at different temperatures.

case at the end of 24 hours. At 10°C, the proportion of conidial germination in the three strains markedly increases with increase of incubation period, being 41.85 per cent for str. I, 35 per cent for str. II, and 64.4 per cent for str. III. There is also a higher proportion of conidial germination (near 100 per cent) in all the strains examined at 35°C, whereas none of the conidia of these strains germinate at 40°C (Plate IX).

As to appressorium formation at the end of 48 hours, the conidia of str. I produced appressoria at the temperatures ranging from 15° to 32.5°C (Plate IX), and those of str. II at the temperatures between 15° and 35°C. In contrast to this, the conidia of str. III did not form any appressoria.

only mycelia continuing to grow (Plate XI). Maximum appressorium formation occurred at the temperatures between 20° and 32.5°C in both strains, the proportion being above or near 100 per cent. At 15°C, appressorium formation in both strains declines, being about 40 per cent, whereas at 32.5°C, it rises to about 93 per cent. At 35°C, a temperature, only 2.5° higher, it drops to only 2.13 per cent in str. II and zero in str. I (Plate IX).

Judging from the foregoing results, the minimum temperature for conidial germination in all the strains examined seems to fall below 10°C, the maximum temperature for it lying between 35° and 40°C, and the optimum temperature for it being between 20° and 32.5°C, perhaps in the vicinity of either 25° or 30°C. The minimum temperature for appressorium formation in both strains, I and II, seems to fall between 10° and 15°C, and the optimum temperature for it between 20° and 32.5°C, the temperature being similar to that for conidial germination. The maximum temperature for appressorium formation seems to lie between 32.5° and 35°C in str. I, and between 35° and 40°C in str. II. It will thus be seen that in strs. I and II, the range of temperature for appressorium formation is narrower than that for conidial germination; and, compared with the other two strains, str. III is evidently characterized by a physiological character, the ability to form appressoria.

2. Effect of temperature on appressorium formation in distilled water

The experiments were made in the same way as that described in the previous section, with the exception that distilled water was used instead of the one per cent glucose solution, in preparing the spore suspension and to serve as the source of sufficient moisture. The same range of temperature was used as in the former experiments, except that the incubation period was 48 hours.

The results are given in Table 4 and Fig. 4.

As will be seen from Table 4 and Fig. 4, in distilled water, germination and formation of appressoria in the conidia of strs. I and II, evidently take place over a wide range of temperature, whereas only conidial germination occurs in str. III, with no formation whatsoever of appressoria. In distilled water, the germ tubes from the conidia of this strain grew only into mycelia, as also in one per cent glucose solution, at all the temperatures at which conidial germination occurred.

The minimum, optimum, and maximum temperatures for conidial germination in the three strains examined agree completely with the results obtained in the preceding section. After 48 hours of incubation, conidial germination in the three strains reached a high percentage at

temperatures of from 15° to 32.5°C, the percentage being almost identical with that in one per cent glucose solution. In contrast to this, at both 10° and 35°C, conidial germination in all the strains was considerably less

TABLE 4. Germination and appressorium formation in the conidia of *P. Oryzae* in distilled water at various temperatures after incubation for 48 hours.

Number of strain	Temperature °C	Number of conidia tested (A)	Germination of conidia		Formation of appressoria	
			Number of germinated conidia counted (B)	Per cent (B/A)	Number of appressoria counted (C)	Per cent (C/A)
I	10	700	18	2.57	0	0
	15	800	785	98.13	216	27.00
	20	800	792	99.00	606	75.75
	25	800	794	99.25	806	100.75
	30	800	785	98.13	815	101.88
	32.5	800	746	93.25	584	73.00
	35	850	125	14.71	0	0
	40	800	0	0	0	0
II	10	800	12	1.50	0	0
	15	00	774	96.75	184	23.00
	20	800	785	98.13	675	84.38
	25	800	793	99.13	795	99.38
	30	800	787	98.38	793	99.13
	32.5	800	781	97.63	698	87.25
	35	700	75	10.71	0	0
	40	600	0	0	0	0
III	10	500	71	14.20	0	0
	15	500	468	93.60	0	0
	20	500	476	95.20	0	0
	25	500	498	99.60	0	0
	30	500	497	99.40	0	0
	32.5	500	496	99.20	0	0
	35	500	112	22.40	0	0
	40	650	0	0	0	0

in distilled water after 48 hours of incubation than that in the glucose solution at the end of the same number of hours, being only 2.57 per cent at 10°C, and 14.71 per cent at 35°C in str. I; only 1.50 per cent at 10°C and 10.71 per cent at 35°C in str. II; and 14.2 per cent at 10°C and 22.4

per cent at 35°C in str. III. These results evidently show that one per cent glucose solution is more favourable for conidial germination in the fungus strains tested than distilled water.

At the end of 48 hours, appressorium formation for the conidia of str. I takes place in distilled water over the same wide range of temperature as in one per cent glucose solution, whereas that of str. II, in distilled water, is restricted to a narrower range of temperature than in the glucose solution, attaining the same range as in str. I, from 15° to 32.5°C.

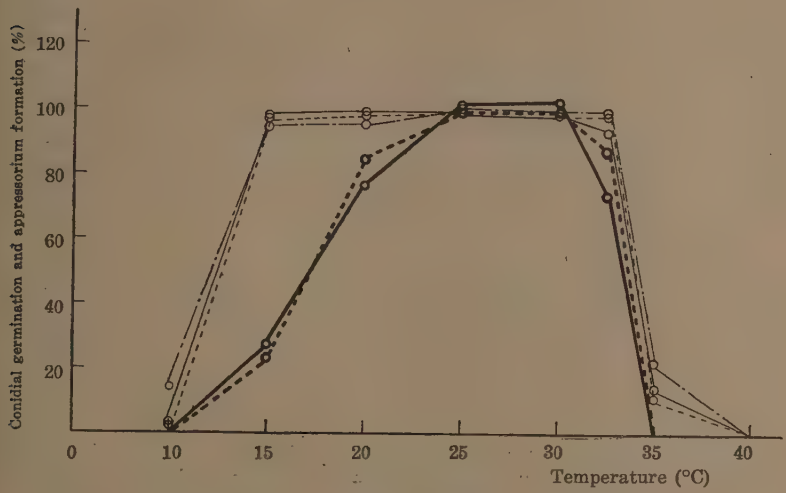

Fig. 4. Germination and appressorium formation in the conidia of *P. Oryzae* grown in distilled water for 48 hours at different temperatures.

Conidial germination { Str. I ——— Str. II - - - - - - - - Str. III — - — - — Appressorium formation { Str. I ——— Str. II - - - - - - - -

So far as the writer's experiments are concerned, the percentage of appressorium formation for the strains is always less in distilled water than in the glucose solution at the temperatures between 15° and 32.5°C. This drop in percentage appears in a large extent either above or below the optimum temperature for appressorium formation which lies in the vicinity of either 25° or 30°C.

From the facts that appressorium formation in both strains showed a lower percentage in distilled water, and that in the case of str. II, it occurred within a narrower range of temperature, one per cent glucose solution seems to favourably affect appressorium formation in both strains.

III. Relation of incubation period to appressorium formation

For the purpose to determine the time which the fungus conidia require to form (either completely or almost completely) appressoria in distilled water and in one per cent glucose solution near the optimum temperature for appressorium formation, an experiment was made in the same way as that described in the preceding chapter. The conidia of two strains, I and II, grown on potato agar with one per cent of sucrose for two weeks at 25°C were used in these experiments. Those of str. III were not examined, as no appressoria were formed under the experimental conditions. As the medium for suspending in it the fungus conidia, one per cent glucose solution and distilled water were used. In using the glucose solution for preparing the spore suspension, about 10 cc of it were introduced into the bottom of each PETRI dish, and when distilled water was used for the same purpose, the same quantity of distilled water was placed in each of the dishes.

TABLE 5. Germination and appressorium formation in the conidia of *P. Oryzae* in one per cent glucose solution and in distilled water at 25°C after various incubation periods.

Medium	Number of strain	Period of incubation (Hour)	Number of conidia tested (A)	Germination of conidia		Formation of appressoria	
				Number of germinated conidia counted (B)	Per cent (B/A)	Number of appressoria counted (C)	Per cent (C/A)
1% glucose solution	I	6	400	383	95.75	0	0
		8	600	600	100.00	12	2.00
		10	500	498	99.60	312	62.40
	II	6	500	423	84.60	0	0
		8	450	450	100.00	208	46.22
		10	600	596	99.33	425	70.83
Distilled water	I	6	400	302	75.50	0	0
		8	500	500	100.00	0	0
		10	650	650	100.00	385	59.23
	II	6	500	408	81.60	0	0
		8	500	500	100.00	126	25.20
		10	600	598	99.67	284	47.33

These PETRI dishes, in which small pieces of cellophane, with a drop of the spore suspension, were floating on the surface of the medium, were placed in a thermostat with the temperature of either 25° or 30°C for

periods of 6, 8, and 10 hours. After a certain period of incubation, both conidial germination as well as appressorium formation were microscopically observed.

Table 5 shows the results of experiments on the relation of incubation period to appressorium formation in distilled water and in one per cent glucose solution at 25°C.

As will be seen from Table 5, a large proportion of conidial germination in both strains occurs in distilled water and in the glucose solution after an incubation period of 6 hours, the percentage being somewhat lower in distilled water than in the other. Moreover, in conidial germination it reaches near maximum percentage in both media at the end of 8 hours of incubation.

In contrast to this, 6-hour incubation is insufficient for the conidia of both strains to produce appressoria in the two media, although a small swelling of the end of the germ tube, a sort of initial appressorium, was sometimes observed in both media at the end of the same number of hours (Plate IX, Fig. 2; Plate X, Fig. 5).

After an incubation period of 8 hours, appressorium formation for the conidia of str. I occurs only in the glucose solution, while that for those of str. II takes place in both media. The proportion of appressorium formation in str. I is still very low even in the glucose solution, being only 2 per cent, whereas that in str. II is comparatively high in both media, being 46.22 per cent in the glucose solution and 25.2 per cent in distilled water. After a longer incubation period of 10 hours, appressoria are formed in str. I, first in distilled water, showing a fairly high proportion, about 60 per cent.

As stated above, appressorium formation for the conidia of both strains occurs more rapidly in the glucose solution than in distilled water.

Regardless of the kind of media used, at the end of 10 hours of incubation, the formation of appressoria in both strains does not reach maximum; for at this incubation period, the percentage of appressorium formation in the glucose solution is 62.40 per cent in str. I and 70.83 per cent in str. II, while that in distilled water is 59.23 per cent in str. I and 47.33 per cent in str. II.

Judging from these experiments, at 25°C, formation of appressoria for str. I in the glucose solution and that for str. II in both media seem to occur between 6 and 8 hours after incubation, and that for str. I in distilled water between 8 and 10 hours. These results show that the time required for appressorium formation in the conidia of str. I is somewhat shorter in the glucose solution than in distilled water, and that the proportion of appressorium formation in str. II as well as in str. I in the glucose solution exceeds that in distilled water.

The results of experiments on the relation of incubation period to appressorium formation in one per cent glucose solution at 25° and 30°C, near the optimum temperature for germination and appressorium formation, are shown in table 6.

TABLE 6. Germination and appressorium formation in the conidia of *P. Oryzae* in one per cent glucose solution at 25° and 30°C after various incubation periods.

Temperature (C)	Number of strain	Period of incubation (Hour)	Number of conidia tested (A)	Germination of conidia		Formation of appressoria	
				Number of germinated conidia counted (B)	Per cent (B/A)	Number of appressoria counted (C)	Per cent (C/A)
25°	I	6	500	490	98.00	0	0
		8	600	598	99.67	21	3.50
		10	550	547	99.45	453	82.36
	II	6	500	497	99.40	0	0
		8	500	495	99.00	42	8.40
		10	500	498	99.60	328	65.60
30°	I	6	500	489	97.80	14	2.80
		8	600	596	99.33	78	13.00
		10	600	597	99.50	503	83.83
	II	6	450	438	97.33	0	0
		8	500	496	99.20	84	16.80
		10	500	497	99.40	405	81.00

As will be seen from Table 6, at the end of incubation for 6 hours, the majority of conidia in both strains germinate in the glucose solution at 25°C as well as 30°C. On the other hand, appressoria are formed in str. I only at 30°C, even although its proportion is very small, only 2.8 per cent, showing that appressorium formation in str. I occurs somewhat more rapidly at 30°C than at 25°C, but in str. II, appressoria are not yet formed.

After an incubation period of 8 hours, appressorium formation takes place in both strains at 25° and 30°C, the proportion of it in both strains being higher at 30°C (13% for str. I; 16.8% for str. II) than at 25°C (3.5% for str. I; 8.4% for str. II), and that at 25°C as well as at 30°C being lower in str. I than in Str. II.

After incubation for 10 hours, appressorium formation in both strains is in fairly large proportions, namely, about 83 per cent at both temperatures in str. I, and 65.6 per cent at 25°C and 81 per cent at 30°C in str. II.

Thus, the proportion of appressoria formed in both strains suddenly increases as the results of continuing the incubation by only two hours, namely, up to 10 hours from 8 hours, although it does not yet reach the maximum formation, showing that, even near the optimum temperature, and even in the glucose solution, which is favourable for appressorium formation, a longer incubation period, namely, more than 10 hours, is necessary for maximum formation of appressoria.

As above mentioned, the proportion of appressorium formation in both strains at the end of incubation period of 6 and 8 hours is higher at 30°C than at 25°C. Such difference, however, disappears by lengthening the incubation period, as shown in str. I at the end of 10 hours and seen from the results summarized in Tables 2 and 3.

From these results, appressorium formation in str. I seems to require an incubation period of less than 6 hours at 30°C and between 6 and 8 hours at 25°C in one per cent glucose solution; and between 8 and 10 hours at 25°C in distilled water. The time necessary for appressorium formation in str. II seems to lie between 6 and 8 hours at 25°C in both media and at 30°C in the glucose solution.

IV. Discussion

In his previous paper (8), the writer already stressed the fact that appressorium formation is in a close relation with entrance of the conidia of *P. Oryzae* into the host plant of rice, because the germ tubes of the fungus conidia have no ability of piercing through the outer walls of the epidermal cells of the host plant, but they are able to penetrate the walls by means of the penetration hyphae which are developed from the appressoria formed on the ends of the germ tubes and adhering to the surface of the plant. Such particular mode of penetration has already been established by several investigators (1, 2, 3, 4, 6, 14, 15). From the numerous inoculation experiments which were reported in the previous papers (10, 11), the writer has also come to the same conclusion, for he failed to observe even a single instance of a direct penetration of the germ tubes of the fungus conidia through the outer walls of the plant cells.

On this reason, the writer believes that the period from conidial germination to the entrance of the penertation hyphae within the epidermal cells of the host plant piercing through the outer walls, may be divided into the following four stages. The first stage is the germination of the conidia; the second, the formation of appressoria; the third, the formation of the penetration hyphae; and the fourth, the penetration of the penetration hyphae piercing through the outer walls of the epidermal cells. He also believes that invasion of the fungus within the host plant cells always

occurs only when the fungus conidia meet with the environmental factors necessary for development of all the four stages, and that these factors affecting each one of the four stages, differ not only in kind but also in extent. For example, the fact that concentration of free oxygen, certain chemical substances, and hydrogen ion, and temperature cause conidial germination over a wider range than they do in appressorium formation, has been experimentally established by the writer (7, 8, 9, 12, 13). Furthermore, he observed that penetration hyphae are rarely developed from the appressoria under the conditions, under which vigorous appressorium formation occurred (Figs. 5–7). Consequently, in studying the mecha-

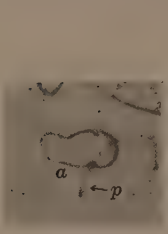

Fig. 5

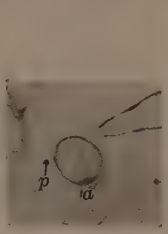

Fig. 6

Fig. 7

Figs. 5–7: Penetration hyphae developed from the appressoria in the conidia of *Piricularia Oryzae* grown in artificial media, using the special method.

Figs. 5 and 6. Appressoria in the conidia of strain I, ca.×850.

Fig. 7. Conidium of strain II, ca.×485.

a: appressorium, *c*: conidium, *g*: germ tube, *p*: penetration hyphae.

nism of invasion of the fungus within the plant cells, it is necessary to explain the effects of these factors at each of the four stages. Obviously, infection of the plant cells after invasion must be studied from a different standpoint. As the writer is now studying the effects of physical and chemical factors upon the develpoment of the four stages for the purpose to explain the mechanisms both of invasion of the fungus within the host plant cells and infection of the plant cells after invasion, the results will be published in due course.

The effect of environmental factors on appressorium formation in the conidia of *P. Oryzae* has been studied by SUEDA (6) and ITO and KURIBAYASI (2). From a number of experiments using the hanging drop culture method, ITO and KURIBAYASI found that in all their experiments, appressoria are usually formed but poorly in distilled water at the temperature of 15°–18° or 18°C, and that no appressorium formation occurs in one per cent glucose and saccharose solutions. In contrast to this, in the writer's experiments conducted by the special method, appressoria are easily formed vigorously in his fungus strains both in distilled water and in one per cent glucose solution. Such discrepancy in appressorium forma-

tion is probably caused by differences in physiological characters of the fungus examined or in the experimental methods employed. It is also probable that poor formation of appressoria in their fungus conidia might be due to deficiency in the indispensable factors, such as free oxygen supply, especially, contact stimulus, seeing that they used the method of hanging drop culture. In fact, SUEDA (6) observed a high proportion of appressorium formation at the margin of hanging drops of distilled water, glucose solution, and other media.

According to the results obtained by ITO and KURIBAYASI (2), appressorium formation for the fungus conidia in distilled water occurred in somewhat higher proportions at the temperature varying from 15° to 18°C than at 25°C, at which last temperature appressoria were rarely formed. From inoculation experiments also, they found that the fungus conidia produced a greater number of appressoria on the host plant at 18°C than at 28°C, and that appressoria, which began to be formed between 6 and 10 hours at 18° and 28°C, increased with prolongation of the incubation period, the proportion of the increase being smaller at 28°C than at 18°C.

As just mentioned, the results on the relation of temperature to appressorium formation which were obtained by ITO and KURIBAYASI (2) are not in agreement with those found by the writer, whereas the time necessary for appressorium formation pointed out by them is almost identical with the writer' results.

After incubation for 48 hours, the writer's fungus, strains I and II, did not produce appressoria at 10° and 35°C, the temperatures at which conidial germination occurred. If the conidia were allowed to incubate for a longer period than 48 hours, the minimum temperature for appressorium formation might have declined to 10°C, or lower, while the maximum temperature might have increased to more than 32.5°C in str. I and more than 35°C in str. II.

The effect of temperature on germination of the fungus conidia has been reported by SUEDA (6), NISIKADO (5), and ITO and KURIBAYASI (2). The optimum temperature for it as obtained by these authors almost agrees with that found by the writer, while SUEDA's minimum temperature is slightly higher than the writer's and the maximum temperature found by SUEDA is somewhat lower than that of the writer.

ITO and KURIBAYASI (2) pointed out that, after 6 hours of incubation, their fungus conidia did not germinate at 18°C and rarely did so at 28°C. The writer's three strains, however, showed a very high proportion of conidial germination in distilled water and in glucose solution at 25° and 30°C after the same incubation period, these results almost agreeing with those obtained by SUEDA (6).

From these facts, the writer's fungus strains, I and II, seem to differ

from the strain of ITO and KURIBAYASI, but resemble the strain of SUEDA in the relation of temperature to conidial germination and to appressorium formation.

When examined at each temperature after the incubation period of 48 hours, no appressoria were formed in strain III, whether in distilled water or in one per cent glucose solution, the germ tubes of the conidia of this strain continuing to grow only into mycelia. From these facts, it seems that, in contrast to the other two strains, str. III is characterized by an important physiological character, namely, to form appressoria. However, from a number of inoculation experiments the writer established that the conidia of this strain have ability not only to form appressoria on the host plant but also to be pathogenic to the host plant of rice.

V. Summary

1. This paper deals with the effect of temperature on germination and appressorium formation in the conidia of *Piricularia Oryzae* BR. et CAV. The results of experiments in connexion with the relation of incubation period to germination and appressorium formation in the fungus conidia are also given.

2. In this investigation, three strains, I, II, and III, all of which were isolated from the interiors of rice seeds, were subjected to experiments in which a special procedure was employed, and the results comparatively examined.

3. The temperature range, within which conidial germination occurs, seems to be almost the same for all the strains examined: from below 10°C to between 35° and 40°C, with an optimum in the vicinity of either 25° or 30°C.

4. By using the special method, vigorous appressorium formation easily takes place in the conidia of strains I and II in distilled water and in one per cent glucose solution, but not in strain III in either media.

5. After germination, the conidia of strain III continued to grow only into mycelia, without forming any appressoria on the ends of the germ tubes. This strain seems to be one of the physiologic specialized forms of the fungus, seeing that in the conidia of this strain, it is possible to have appressoria formed on the host plant, and also to cause blast disease.

6. Appressorium formation for the conidia of strains I and II seems to take place over a narrower range of temperature than that in conidial germination. At the end of 48 hours of incubation, the minimum temperature for appressorium formation in strains I and II seems to lie between 10° and 15°C, while the optimum temperature for it seems to be

identical with that for conidial germination. The maximum temperature for appressorium formation in strain I seems to lie between 32.5° and 35°C.

7. The maximum temperature for appressorium formation in the conidia of strain II seems to differ with the media in which the conidia are suspended. After incubation for 48 hours, it seems to lie between 35° and 40°C in one per cent glucose solution, and between 32.5° and 35°C in distillled water.

8. The time required for appressorium formation seems to vary with the strains, the temperatures, and the media. At 25°C, the time necessary for appressorium formation in the conidia of strain I seems to lie between 6 and 8 hours in one per cent glucose solution, and between 8 and 10 hours in distilled water, whereas, at 30°C, it seems to lie in less than 6 hours in the same glucose solution. The time necessary for appressoria to be formed in the conidia of strain II seems to lie between 6 and 8 hours in both media at 25°C and in the same glucose solution at 30°C.

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Explanation of plates IX—XI

Photomicrographs of germination and appressorium formation in the conidia of *Piricularia Oryzae* Br. et Cav. at various temperatures and after various incubation periods, ca.×485.

Plate IX: Conidia of strain I grown in one per cent glucose solution for 48 hours at various temperatures.

Fig. 1. At 10°C; Fig. 2. At 15°C; Fig. 3. At 20°C; Fig. 4. At 25°C; Fig. 5. At 30°C; Fig. 6. At 32.5°C; Fig. 7. At 35°C; Fig. 8. At 40°C.

Plate X:

Figs. 1–4. Conidia of strain II grown in one per cent glucose solution for 15 hours at various temperatures.
Fig. 1. At 20°C; Fig. 2. At 25°C; Fig. 3. At 30°C; Fig. 4. At 32.5°C.
Figs. 5–8. Conidia of strains I and II grown in distilled water and in one per cent glucose solution for 8 and 10 hours at 25°C.
Fig. 5. Conidia of strain I grown in distilled water for 8 hours.
Fig. 6. Conidia of strain II grown in distilled water for 8 hours.
Fig. 7. Conidia of strain I grown in one per cent glucose solution for 10 hours.
Fig. 8. Conidia of strain II grown in one per cent glucose solution for 10 hours.

Plate XI: Conidia of strain III grown in one per cent glucose solution for 48 hours at various temperatures.

Fig. 1. At 15°C; Fig. 2. At 20°C; Fig. 3. At 25°C; Fig. 4. At 30°C; Fig. 5. At 32.5°C; Fig. 6. At 35°C.

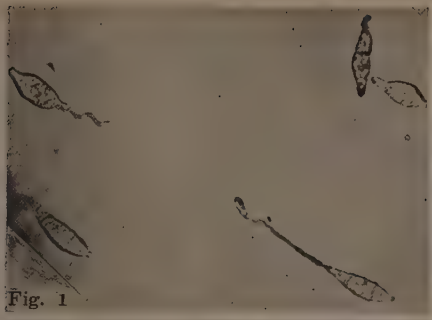


Fig. 1

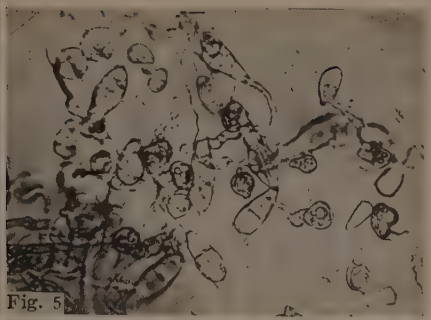


Fig. 5


Fig. 2

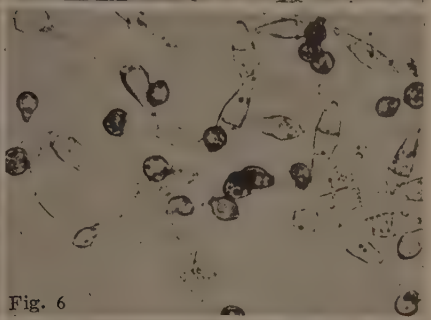
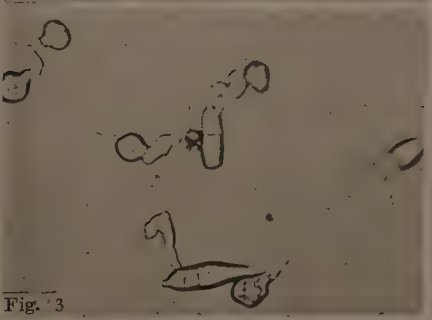


Fig. 6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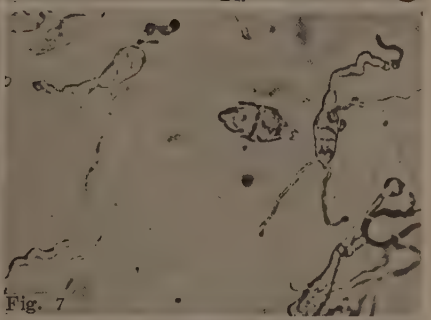
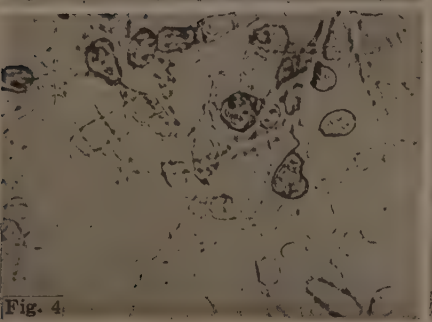


Fig. 7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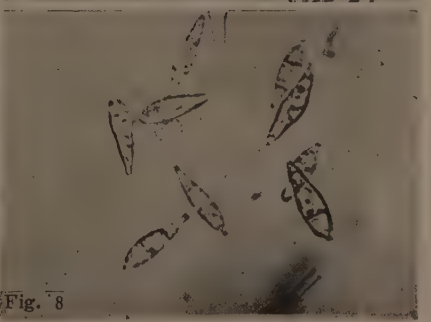
Fig. 8


Fig. 1


Fig. 5

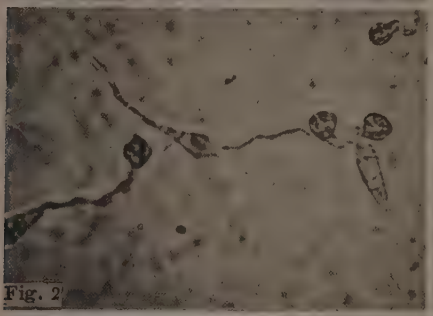
Fig. 2

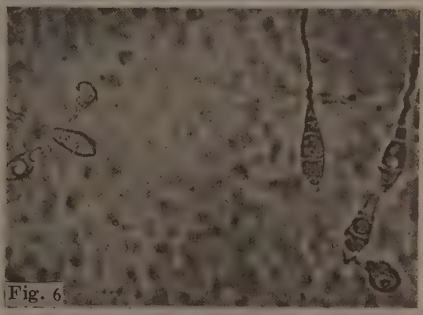
Fig. 6

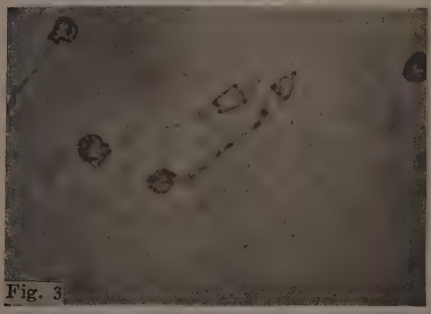
Fig. 3

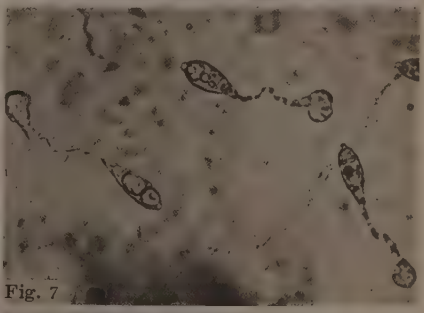
Fig. 7


Fig. 4

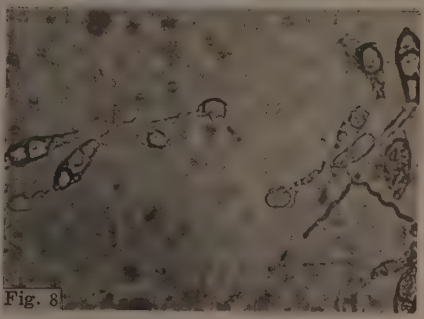
Fig. 8

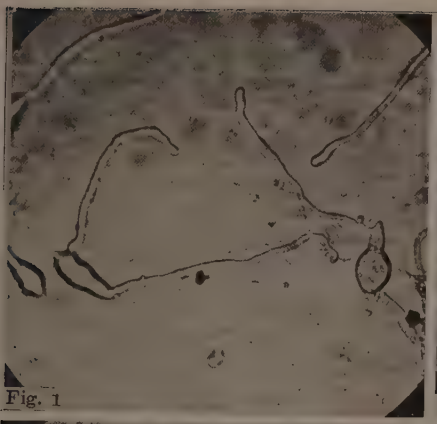

Fig. 1

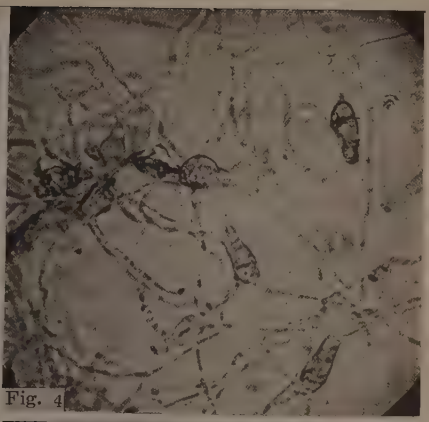

Fig. 4

Fig. 2

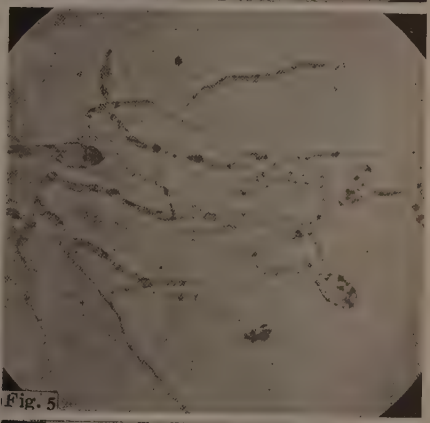

Fig. 5

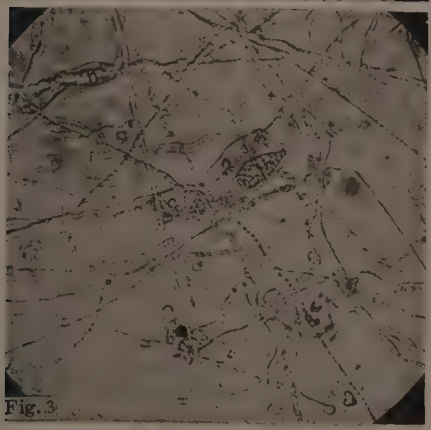

Fig. 3

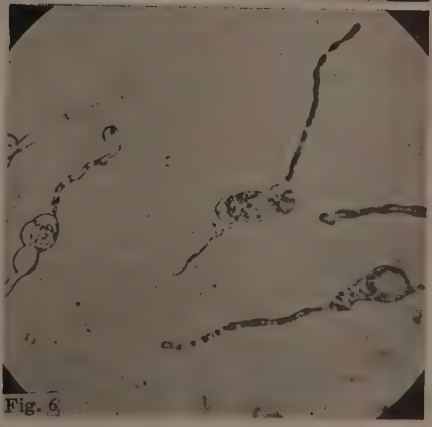

Fig. 6

Floral remains of the Conifer Age at Manzidani near Nisinomiya, Japan

(Preliminary note)

By Shigeru MIKI

With 3 text-figures

(Received August 2, 1941)

In one of my previous papers (1938, p. 228) I have reported a cool and humid coniferous flora in the Tatikawa bed at Egota (Ekoda), Tokyo. Since then I have endeavoured to seek the same floral remains in order to extend our knowledge of that age. Last month I could find in the Pleistocene deposits of Nisinomiya (5), between Kobe and Osaká, almost the same floral remains as mentioned previously.

The bed laid at Nisinomiyaboti, hilly upland, nearly 50 m above sea level is situated about 7 km south-east from Mt. Rokko (932 m) and about 2 km south from Kabutoyama (309 m).

The profile of the sedimentations is shown in Fig. 1. Various floral remains are found from the layers, B, D, E, G, H, but the characteristic remains here concerned are found from the layer E, which is designated hereafter as the *Larix* bed. The nearly same remains were also found at Asiyagawa, 4 km west from the bed and Kamikusiro in Kawanisi, 9 km northeast from the bed.

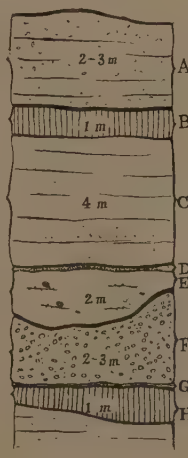

Fig. 1. Profile of the *Larix* bed of Manzidani in Nisinomiya. (Diagrammatic).

A Sand and gravel layer.
B Bluish clay with remains of *Ruppia, Paliurus,* etc.
C Sand or clay layers.
D Clay with remains of *Sabia, Magnolia,* etc.
E White clay or silt with remains of *Larix Kaempferi, Pinus koraiensis,* etc.
F Gravel layer with a demarcation of limonite between the layer E above.
G Thin layer of lignite with remains of *Cryptomeria, Sciadopitys, Chamaecyparis,* etc.
H Bluish clay with remains of *Sapium, Paliurus,* etc.

The place of deposition of the bed seems to be a lacustrine deposit, as there are many associated remains of fresh water plants, such as *Trapa incisa, Ceratophyllum, Potamogeton* and *Sparganium* (Fig. 2 *L*), while the layers B and H seem

to be an aestuary deposit, as there occur remains of *Ruppia, Paliurus,* drift wood bored by *Teredo* and they emit the odour of sulphite, as it is usually the case in marine deposit. The rest of the layer seems to be lacustrine or fluvial, because it is destitute of either characteristic marine remains or of the sulphite odour.

Floral remains in the *Larix* bed

In the bed there were found the following 16 species, of which 8 belong to the Coniferae:

Pinaceae:

1. *Abies* cf. *Veitchii* MASTERS. (Fig. 2 G).

A cone-scale and a few leaves were found in the bed. Scale 10 mm broad, 5 mm high, incurved at the margin, bract broad, but broken at its margin.

The remains were identified by incurved scale margin and broad bract.

The species is now living only in Central Japan at about 2000 m above sea level.

2. *Larix Kaempferi* SARG. (Fig. 2 D–F).

Many cones, seeds, branches and leaves occurred in the bed. In respect to the size and shape of the bract on the cone-scale the remain is similar to either *Larix Kaempferi* SARG. or *Larix Gmelini* PILG., but it differs from the latter by the orbicular shape of cone-scale.

Fig. 2. The *Larix* bed and remains in it (excl. N–O). (Scales in mm unit).

A A view of the locality. *L Larix* bed. The hill over there is Kabutoyama.
B *Chaemaecyparis pisifera* S. et Z. from *Larix* bed.
C *Thuja protojaponica* n. sp. *a* from *Larix* bed, *b–c* from cliff of Asiyagawa.
D–F *Larix Kaempferi* SARG. from *Larix* bed. D branches (*a*) and cones (*b*); E leaves; F seeds.
G *Abies Veitchii* LINDL. from *Larix* bed.
H *Tsuga* cf. *oblonga* MIKI from *Larix* bed.
I *Picea Maximowiczii* REGEL from *Larix* bed: *a* cone-scale from inner side, *b* shoots, *c* leaves, *d* seeds.
J *Picea jezoensis* CARR. var. *hondoensis* REHD. from *Larix* bed.
K *Pinus koraiensis* S. et Z. from *Larix* bed.
L Seeds of water plants from *Larix* bed: *a Sparganium minimum* FRIES, *b Ceratophyllum demersum* L., *c Potamogeton perfoliatus* L.
M *Corylus heterophylla* L. from *Larix* bed. ×1.
N *Schizandra phytolaccoidea* n. sp.: *a* (upper right) from layer E, others from Narasaka.
O *Symplocos reticulata* n. sp.: *a* (two on the left) from the layer E, others from Narasaka.


A
B
L
C
a
b
c
G
a
D
H
M
b
F
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d
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N
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a
L
a
b
c
J
a
b

The distribution of the species in wild state is now restricted to Central Japan, about 1500–2500 m above sea-level.

3. *Picea jezoensis* CARR. var. *hondoensis* REHD. (Fig. 2 J).

Many leaves and a cone were found in the bed. Although the cone is incomplete it is identified to the species on account of small scales with robust base and hypostomatic flat leaves.

The species is now living only in Central Japan at about 2000 m above sea level.

4. *Picea Maximowiczii* REGEL. (Fig. 2 I).

A cone-scale, seeds and a few leaves were found in the bed. It is identified to the species by tetragonal narrow leaf with stomata on all sides and by the large-sized cone-scale with entire margin.

The species now lives only in the mountains of Central Japan, about 2000 m above sea level.

5. *Pinus koraiensis* S. et Z. (Fig. 2 K).

Many seeds and a fascicle of leaves were found. Seed obovate, 12–15 mm long, 9–10 mm broad. Leaves five in a fascicle.

The remains are identical to the living species now growing at about 1500–2500 m above sea level in Central Japan and Korea.

6. *Tsuga* cf. *oblonga* MIKI. (Fig. 2 H).

A cone-scale and a few leaves were found. Scale oblong with conspicuous bract. Scale resembles that of the species but can not be identified strictly on account of incomplete remain.

Cupressaceae:

7. *Chamaecyparis pisifera* S. et Z. (Fig. 2 B).

Many cones and branches were found in the bed. On account of small cone and acute leaves the remain resembles *Chamaecyparis formosensis* MATSUM. and C. *pisifera* S. et Z., but differs from the former by central position of bract on the seminiferous scale and separable wing on the seed.

The species now lives only in Central to Northern Japan, about 1000–1500 m above sea level.

8. *Thuja protojaponica* n. sp. (Fig. 2 C).

Many fragmental shoots were found in the bed. The same cones were also found in Asiyagawa, together with shoots (Fig. 2 Cb–c). Shoot tenuous, constricted by short and curved leaves. Cone 12 mm long, 5–6 mm broad. Bract on the cone-scale is somewhat shorter than the seed-scale.

At a glance the shoot seems like that of *Thuja occidentalis* L., but it differs from it by shorter bract, and from *Thuja Standishii* CARR. by constricted tenuous shoots.

Other localities in Japan: Kwankokei in Koori; Betusyoyama in Hirakata-higasiguti, Pref. Osaka; Taniguti in Hukakusatyo, Pref. Kyoto; Tu, Pref. Mie.

Betulaceae:

9. *Alnus* sp. Many cones occurred.
10. *Corylus heterophylla* FISH. A few seeds were found (Fig. 2 M).

Ceratophyllaceae:

11. *Ceratophyllum demersum* L. Two seeds were found (Fig. 2 Lb).

Rosaceae:

12. *Prunus salicina* LINDL. Many endocarps and fruits were found.

Aceraceae:

13. *Acer* cf. *Miyabei* MAX. Only one seed was found.

Hydrocaryaceae:

14. *Trapa incisa* S. et Z. A few fruits were found.

Sparganiaceae:

15. *Sparganium minimum* FRIES. Many endocarps were found (Fig. 2 La).

Potamogetonaceae:

16. *Potamogeton perfoliatus* L. Many seeds occurred (Fig. 2 Lc).

Distribution of floral remains of the associated layers in Kinki-district

There are also many remains in the associated layers B, D, G and H, which may be enumerated as follows:

B

1) *Chamaecyparis obtusa*
2) *Pinus Armandi*
3) *Fagus Hayatae*
4) *Sapium sebiferum* var.
5) *Paliurus nipponicus*
6) *Styrax japonicum*
7) *Potamogeton pectinatus*
8) *Ruppia maritima*

H

1) *Pinus densiflora*
2) *Sapium sebiferum* var.
3) *Euscaphis japonica*
4) *Paliurus nipponicus*
5) *Styrax japonicum*

D

1) *Fagus Hayatae*
2) *Viscum* sp.
3) *Schizandra phytolaccoidea* n. sp. (Fig. 2 N)
4) *Magnolia kobus*
5) *Benzoin umbellatum*
6) *Sabia japonica*
7) *Berchemia racemosa*
8) *Fagara ailanthoides*
9) *Xanthoxylum piperitum*

10) *Cicuta virosa*
11) *Symplocos reticulata* n. sp. (Fig. 2 O)
12) *Phyllostachys* sp.

G

1) *Abies firma*
2) *Chamaecyparis obtusa*
3) *Chamaecyparis pisifera*
4) *Cryptomeria japonica*
5) *Pinus Thunbergii*
6) *Sciadopitys verticillata*
7) *Tsuga* cf. *oblonga*
8) *Alnus* sp.
9) *Neolitsia aciculata*
10) *Buxus japonica*
11) *Acer* sp.
12) *Viburnum furcatum*

In the layers B and H are predominating *Paliurus* and *Sapium*, which are also widely distributed in Kinki-district, as seen in Fig. 3.

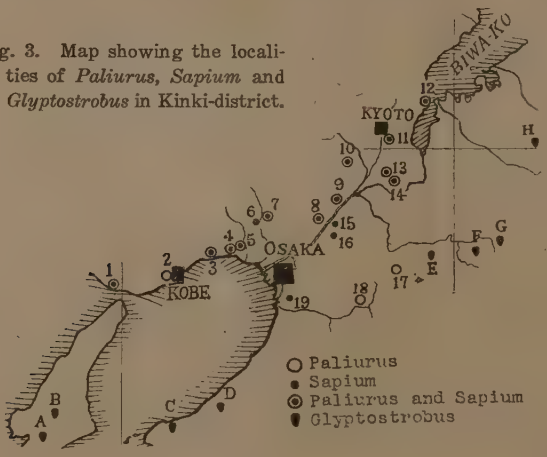

Fig. 3. Map showing the localities of *Paliurus*, *Sapium* and *Glyptostrobus* in Kinki-district.

1. *Stegodon*-bed in Akasi.
2. Nagura in Hayasidaku, Kobe.
3. Cliff of Asiyagawa.
4. Manzidani in Nisinomiya.
5. Hirotayama near Nisinomiya.
6. Kamikusiro in Kawanisi, Pref. Hyogo.
7. Simosibutani in Ikeda.
8. Sozizi in Settutonda.
9. Betusyo in Takatukityo.
10. Iwamikamisato near Mukomati.
11. Hiyosityo in Higasiyama, Kyoto.
12. Ogimura near Katada.
13. Taniguti in Hukakusatyo.
14. Obakusan, Pref. Kyoto.
15. Betusyoyama in Hirakatahigasiguti.
16. Kwankokei in Koori.
17. Cliff of Kyusenro in Narasaka.
18. Midorigaoka in Ozi, Pref. Nara.
19. Turugaoka in Sumiyosiku, Osaka.

A Lignite bed of Takahagi in Kasyumura, Awazi.
B Lignite bed of Doi in Hitoori, Awazi.
C Clay bed of Huke, Sennangun.
D Clay bed of Tutimaru in Sennangun.
E Clay bed of Ryo in Sagawa, Pref. Nara.
F Clay bed of Sidatani in Simagahama, Iga.
G Lignite bed of Sabutani near Simagahara, Iga.
H Lignite bed of Kaikake, Pref. Siga.

The remains in the layer D show us that the climate of the bed was milder than that in the foregoing *Larix* bed, as there occurs *Sabia* as an indicator of warmer climate. The remains of the layer D are found in other localities, as in Sozizi and Narasaka, together with those enumerated in the layers B and H.

The layer G, though poor in its development, still contains a rich flora with many Coniferae, such as *Abies, Pinus, Tsuga, Cryptomeria, Sciadopitys* and *Chamaecyparis*. The beds with similar floral remains are also found in Asiyagawa, Hirotayama and Kamikusiro in Kinki-district.

The relationship of these beds with the clay or lignite beds in Kinki-district which contain *Glyptostrobus, Nyssa*, etc., as noted in my previous paper (1941), will be discussed later.

Floral character of the *Larix* bed

A striking fact of the *Larix* bed is that there are 50% of Coniferae, most of which are living species or closely related allies of those now growing about 1000–2000 m above sea level in Central Japan or Korea, as *Larix, Picea* and *Pinus koraiensis*. The climate of the bed should have been, therefore, cool and humid.

The composition of the remains corresponds closely to the flora of the Conifer Age of Egota (Ekoda), so the bed is considered to be of the same age.

In this study I am greatly obliged to the Imperial Academy of Japan, for financial assistance.

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2. Miki, S. (1937): Plant fossils from the *Stegodon* beds and the *Elephas* beds near Akasi. (Jap. Journ. Bot. **8**, 303–340).
3. Miki, S. (1938): On the change of flora of Japan since the Upper Pliocene and the floral composition at the present. (Jap. Journ. Bot. **9**, 213–250).
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5. Ueji, T. (1936): The cainozoic strata and their structure in the southern margin of the Rokko Mass. (Jap.) (Chikyu (The Globe) **25**, 321–330, 409–425).

ABSTRACTS

EXPLANATION OF ABBREVIATIONS OF THE JOURNALS' NAMES REFERRED IN THE ABSTRACTS CONTAINED IN THIS NO.

Abbreviations	*Names of Journals*
A. H.	Agriculture and Horticulture (農業及園藝)
A. PP. S. J.	Annals of the Phytopathological Society of Japan (日本植物病理學會報)
A. PT. G.	Acta Phytotaxonomica et Geobotanica (植物分類地理)
B. M. T.	The Botanical Magazine, Tôkyô (植物學雜誌)
B. S., F. T., K. I. U.	Bulteno Scienca de la Fakultato Terkultura, Kyûsyû Imperia Universitato (九州帝國大學農學部學藝雜誌)
B. T. S. M.	Bulletin of the Tokyo Science Museum (東京科學博物館研究報告)
B. Z.	Botany and Zoology (植物及動物)
Cyt.	Cytologia
E. R.	Ecological Review (生態學研究)
Jap. J. B.	Japanese Journal of Botany
J. Jap. B.	Journal of Japanese Botany (植物研究雜誌)
J. F. A., H. I. U.	Journal of the Faculty of Agriculture, Hokkaido Imperial University
J. F. S., I. U. T.	Journal of the Faculty of Science, Imperial University of Tokyo
J. J. G.	Japanese Journal of Genetics (遺傳學雜誌)
J. S. T. A.	Journal of the Society of Tropical Agriculture (熱帶農學會雜誌)
P. C. S. S. J.	Proceedings of the Crop Science Society of Japan (日本作物學會報)
P. I. A.	Proceedings of the Imperial Academy
Sc. Rpts., T. BR. D.	Science Reports of the Tokyo Bunrika Daigaku
Sc. Rpts., T. I. U.	Science Reports, Tôhoku Imperial University
Sc. S. S. I.	Science of South Sea Islands (科學南洋)
T. S. N. H. S.	Transactions of the Sapporo Natural History Society (札幌博物學會報)
T. N. H. S. F.	Transactions of the Natural History Society of Formosa (臺灣博物學會報)
T. T. S. A. S.	Transactions of the Tottori Society of Agricultural Science (鳥取農學會報)

Abstracts Nos. 273-429

(Referring to the principal papers in Botany and allied subjects which have appeared in Japan mostly during July–December 1940)

273. Meiotische Teilung von *Dictyosiphon foeniculaceus*. Kôgorô ABE. (Sc. Rpts., T.I.U. **15**, 1940, 317–320, 1 Taf. und 2 Textfig.).

Die Entwicklungsgeschichte von *Dictyosiphon foeniculaceus* (HUDS.) GREV. wurde von SAUVAGEAU verfolgt und dann dafür wurde eine neue Ordnung Dictyosiphonaceae errichtet. Dabei gibt es beide uni- und plurilokulare Sporangien. Der Verf. hat zytologisch die Entwicklung der Schwärmer im unilokularen Sporangium näher untersucht. Er gibt im vorliegenden Aufsatz die Figuren der sukzessiven Kernteilungsstadien in der Mutterzelle der Fortpflanzungsorgane, nämlich, Ruhe, Synapsis, Spirem und Diakinese. Die Zahl der Chromosomen beträgt 18; kein zentrosomartiges Körperchen am Spindelpol ist nachweisbar. Nach den zweimaligen Teilungen entstehen vier Zellkerne und dann folgen weitere simultane Kernteilungen. Das Sporangium vergrössert sich und das Protoplasma teilt sich in vielen einkernigen Portionen. Jede der letzteren bekommt ein Chromatophor und entwickelt sich zu einem Schwärmer.

Die Individuen mit unilokularen Sporangien sind diploid und äusserlich stattlich. Die zwei ersten Kernteilungen stellen die Reduktionsteilungen dar. Die daraus entwickelten Individuen mit plurilokularen Sporangen sind haploid und zwerghaft. Somit ist es hier ein regelmässiger Generationswechsel nachweisbar.

274. Ueber die physiologischen Untersuchungen der Sporenkeimung bei Myxomyceten. I. Einfluss des osmotischen Wertes des Mediums bei Sporenkeimung. (Vorläufige Mitteilung). (Japanisch m. deutsch. Zfg.). Seiji ABE. (B.M.T. **54**, 1940, 446–452).

Die Keimungsversuche der Myxomycetensporen (*Fuligo septica*, *Reticularia Lycoperdon*) sowohl im destillierten Wasser als in den Lösungen von Rohrzucker, Traubenzucker und KCl verschiedener Konzentrationen wurden ausgeführt. Nach der Sporenquellung darin kommt der Austritt des Sporeninhaltes am kürzesten im destillierten Wasser zu stande, und je konzentrieter die benutzten Lösungen sind, desto mehr wird der Austrittsvorgang verzögert. Im reinen Wasser oder in sehr schwachen Lösungen findet die Desorganisation des Sporeninhaltes statt, oder die mit ungemein grossen Vakuolen ausgestatteten Schwärmer werden sich entwickeln. Bei hochkonzentrierten Lösungen ist zwar der Austritt verzögert, doch wird die Entwicklung der Schwärmer beschleunigt. Man kann sagen, dass für die Entwicklung der normalen Schwärmer die Lösungen gewisser Konzentration notwendig ist.

275. On the pathological histology of the deformed petioles and leaves of *Camellia japonica* caused by an undetermined species of *Exobasidium*. (Japanese with English résumé). Shigeyasu AKAI. (A.PP.S.J. **10**, 1940, 104–109, 4 text-figs.).

The deformation of petioles and leaves of *Camellia japonica* caused by a non identified species of *Exobasidium* is due to the hypertrophy of cells and not to their hyperplasia, so that the number of cell-layers remains unchanged. The arrangement of hypertrophied cells is regarded to be due to the osmomorphosis. The hymenium develops under the epidermis or in the intercellular space of some epidermal layers. The overlying layers are later ruptured, and the hymenium is exposed externally.

276. Tetraploid PMCs of *Rhoeo* induced by low temperature treatment. (Japanese with English résumé). Toshio AKEMINE. (J.J.G. **16**, 1940, 149–154, 18 text-figs.).

The pots with *Rhoeo discolor* were transferred from the greenhouse at 23°C to the place of 2°, and were returned to the original house after 4 hours. In the plants thus treated a considerable number of tetraploid PMCs were found, mixed with normal diploid ones. Univalents, ring bivalents, chains of three or more chromosomes, rings of four chromosomes and polyvalents bearing triple terminal chiasmata were observed in certain stages of meiosis. According to the author the origin of these 4x PMCs should be ascribed to the failure of cytokinesis at the last mitosis in the archesporial tissue affected by low temperature. The chromosome configuration observed will lead to the assumption that *Rhoeo* is an interchange heterozygote as has been hitherto inferred on some other ground.

277. On the systematic anatomy of the leaves of some Japanese *Carices* XXIX-XXX. (Japanese with English résumé). Shigeo AKIYAMA. (B.M.T. **54**, 1940, 303–307, 6 text-figs.-groups).

Leaves of the following species of *Carex* were studied anatomically: *C. Thunbergii*, *C. subspathacea*, *C. rikuchiuensis*, *C. Okuboi*, *C. Doenitzii* and *C. pseudo-Doenitzii*.

278. Lichenologische Notizen XII-XIV. (Japanisch, deutsch u. lateinisch). Yasuhiko ASAHINA. (J. Jap. B. **16**, 1940, 401–402, 2 Textfig.; 517–522, 3 Textfig.; 592–603, 8 Textfig.).

Cladonia macroptera RÄSÄNEN sp. nov. ist nach dem letzteren Autor mit *Cl. squamosa* var. *phyllocoma* systematisch nahe verwandt. Nach näherer Untersuchung ASAHINAs nähert sich diese Flechte eher *Cl. furcata* wegen der Struktur der Markschicht sowie chemischer Reaktion. Er unterscheidet dabei zwei neue Formen, nämlich, forma *ramosa* und *subnuda*.

Pannarin.-Obschon das Markgewebe einiger *Pannaria*arten wegen ihrer orangeroten Reaktion gegen Paraphenyldiamin, Protocetrarsäure oder Fumarprotocetrarsäure zu enthalten scheine, ist dies nicht der Fall; sie enthält einen farblosen Depsidaldehyd $C_{18}H_{15}O_6Cl$, welches durch seinen Entdecker YOSIOKA "Pannarin" genannt wird.

Cladonia cariosa (ACH.) SPRENG.-Seit der NYLANDERs Erwähnung ihrer Vorkommen in Japan (1890) hat ASAHINA erst im Jahre 1932 sie in Saghalien bekommen können. ZOPF hat das Enthalten von Atranorin und Bryopogonsäure in dieser Flechte erwähnt. Die Experimente des Verfs. durch gewisse chemische Methoden haben das Vorkommen von Atronorin bestätigt (PD+ gelb). Die zweite Substanz, welche schweifförmiggruppierte, haarfeine farblose Nadeln bildet, ist noch nicht sicher identifiziert, doch handelt es sich wohl um eine Säure der Fettreihe.

HESSE hat das Vorkommen von Bryopogonsäure und Alectorsäure in *Alectoria implexa* (HOFFM.) erwähnt, obschon ZOPF, inbezug auf seine gleichnamige Flechte die Ergebnisse HESSEs nicht bestätigen konnte. Für die Diskussion Verfs. über diesbezügliche Chemie sei auf das Original verwiesen.

Es gibt etwa 6 Arten von am Rande des Thallus bewimperten Parmelien, welche oft für die Identifizierung die Schwierigkeit bieten. Mittels der mikrochemischen Reaktionen hat der Verf. versucht, die DU RIETZschen Arbeiten zu ergänzen. Diese 6 Arten sind *Parmelia cetraria* ACH., *P. reticulata* TAYL., *P. trichoptera* HUE, *P. Arnoldii* DU RIETZ, *P. crinita* ACH. und *P. suberinita* NYL. Die Bestimmungstabelle für diese 6 Arten ist angegeben.

279. *Cladonia verticillata* HOFFM. und *Cladonia calycantha* (DEL.) NYL. aus Japan. (Japanisch m. deutsch. Zfg. u. latein. Diagnosen). Yasuhiko ASAHINA. (J. Jap. B. **16**, 1940, 462–470, 3 Textfig.).

Inbezug auf *Cladonia verticillata* unterscheidet der Verf. die drei folgenden neuen Varietäten, nämlich, *subevoluta*, *subsobolifera* und *sublepida*, und weiter eine neue Unterart *dissimilis*.

Eine eingehende Diskussion über *Cladonia calycantha* (DEL.) NYL. folgt.

280. Chemismus der Cladonien unter besonderer Berücksichtigung der japanischen Arten. (M. japan. Zfg.). Yasuhika ASAHINA. (J. Jap. B. **16**, 1940, 709–727).

Cladonia chlorophaea, welche zuerst eine Varietät von *Cl. pyxidata* gewesen ist, wurde zu einer selbständigen Art erhoben, nachdem ZOPF darin neben der bitterschmeckenden Fumarprotocetrarsäure ein specifisches Stoffwechselprodukt, die Chlorophaeasäure, nachgewiesen hatte, welche in typischer *Cl. pyxidata* fehlt. Seither hat man alle sorediöse Formen der *Cl. pyxidata*-Gruppe zu *Cl. chlorophaea* zugewiesen, ohne das Vorhandensein der Chlorophaeasäure festzustellen. Nun hat der Verf. neuerdings eine Anzahl von europäischen und amerikanischen Formen von *Cl. chlorophaea* mikrochemisch untersucht und war von der Tatsache überrascht, dass diese sog. Art ein Gemenge von ziemlich heterogenen Formen ist. Für den Nachweis der Chlorophaeasäure war die schön purpurrote Färbung durch Chlorkalk nach dem Betupfen mit Kalilauge als eine charakteristische Reaktion in Anwendung. Nach den Verfs. Untersuchungsresultaten muss man bei solchen KC positiven Exemplaren zwei durch ihre respektive Stoffwechselprodurkte scharf unterscheidbare Arten annehmen, nämlich *Cl. cryptochlorophaea* ASAHINA und *Cl. merochlorophaea* ASAHINA, welche durch das Enthalten der neuentdeckten Stoffwechselprodukte, Cryptochlorophaeasäure (Schmelzpunkt 166°) bzw. Merochlorophaeasäure (Schmelzpunkt 153°) charakterisiert sind. Bei jeder von zwei obengenannten Arten hat der Verf. beide die KC positiven und negativen (f. *inactiva*) Formen unterscheiden können. Weiter, *Cl. Grayi* MERRELL welche auch zu der *Cl. chlorophaea*-Gruppe gehört, ist durch den Mangel der bitterschmeckenden Fumarprotocetrarsäure ausgezeichnet, und darin hat der Verf. immer ein neues Stoffwechselprodukt des hohen Schmelzpunktes (183°) nachgewiesen, welches die Grayaninsäure genannt wird.

Fussend auf die obigen Studien hat der Verf. bei japanischen Exemplaren von *Cl. chlophaea*-Gruppe die folgenden vier Arten unterschieden: 1. *Cl. cryptochlorophaea* ASAHINA (KC+, Cryptochlorophaeasäure enthaltend), 2. *Cl. merochlorophaea* (KC+, Merochlorophaeasäure enthaltend), f. *inactiva* (KC—), 3. *Cl. Grayi* MERRELL var. *squamulosa* SANDST. (PD—, Grayaninsäure enthaltend) und 4. *Cl. chlorophaea* (FLK.) ZOPF emend. ASAHINA (KC+, wo die Fumarprotocetrarsäure als alleiniges Stoffwechselprodukt nachgewiesen werden kann).

281. Notes on new and critical Far Eastern *Phyllanthus*. Leon CROIZAT. (J. Jap. B. **16**, 1940, 646–658).

The following species of *Phyllanthus* incl. 2 new species are enumerated with critical notes: *Ph. flexuosa* (S. et Z.) MUELL. ARG., *Ph. Clarkii* HOOK. fil., *Ph. Rheedii* WIGHT, *Ph. Hookeri* MUELL. ARG., *P. subpulchellius* (Eriococcus) CROIZ. sp. nov., *Ph. Forestii* (W. W. SM.), *Ph. Bodinieri* (LÉVEIL.) REHD., *P. Franchetianus* LÉVEILLÉ *Ph. asteranthos* CROIZ. sp. nov., (subg. Eriococcus), *Ph. urinaria* L., *Ph. parvifolius* BUCH.-HAM.

282. Studien über die Thermalflora von Japan (III). Thermale Bakterien und Algen aus den thermalen Quellen von Hakone. (Japanisch m. deutsch. Zfg.). Yoshikazu EMOTO und Hiroyuki HIROSE. (J. Jap. B. **16**, 1940, 405–420, 5 Textabb.).

In dem berühmten Badeort Hakone sieht man zahlreiche Thermen, sowohl salz- als schwefelhaltig. Die Verff. fanden dabei im ganzen 5 Arten Bakterien, 23 Arten und Varietäten Cyanophyzeen, 4 Arten Chlorophyzeen, 1 Art Heteroconten und 2 Arten Diatomeen, weiter die folgenden Arten, welche noch nicht sicher bestimmt worden sind, nämlich 2 Arten Cyanophyzeen, je 1 Art aus Chlorophyzeen, Konjugaten und Rhodophyzeen.

Die folgenden Arten sind zum ersten Male als Bewohner der Thermalquellen Japans erkannt:

Cyanophyzeen: *Microcystis marginata, Aphanothece nidulans, Gloethece atrata, Synechococcus arcuatus. Fisherella ambigua, Hapalosiphon hibernicus. Scytonema ocellata, Tolypothrix bissoides, Oscillatoria pernides, Lyngbya subconfervoides.*

Chlorophyzeen: *Sphaerocystis Schroeteri, Stigeoclonium flagelliferum, Gomontia Holderii.*

Diatomeen: *Fragilaria brevistricta, Triceratium whampoense.*

Weiter sind 3 neue Varietäten, *Synechococcus lividus* var. *non-granulatus*, *S. vescus* var. *non-granulatus* und *Rhabderma lineare* var. *minor* aufgefunden.

283. Studies on the thermal flora of Japan VI. Bacteria and algae of the Ibusuki thermal springs. (Japanese with English résumé). Yoshikazu EMOTO and Yûiti YONEDA. (E.R. **6**, 1940, 257–274, 9 text-figs.).

The Ibusuki district, situated at the southern end of Kyûsyû Island, is distinguished by the presence of innumerable hot springs, which are known under the collective name Ibusuki hot springs group. All hot springs there are murated, with one single exception which is sulphurous. The temperature lies between 34.2°–46° (Unagi).

The authors have collected in these springs 2 species of bacteria, 28 species and 5 varieties of Cyanophyceae and some diatoms. All (except the diatoms) are indicated in a table, showing the temperature and pH of the springs where they are living. The inspection of this table indicates that, firstly, 4 new species of Cyanophyceae were discovered, viz. *Synechococcus praelongus, S. sublividus, Microchaete thermalis*, and *Oscillatoria ibusukiensis;* secondly, *Synechococcus elongatus* var. *amphigranulatus* can live in hot spring of 63°; thirdly, the hot spring of high temperature allows extravagant growth of some species of *Synechococcus;* and fourthly, in Unagi, single sulphurous hot spring in this district, the vegetation is poorly developed, some sulphur bacteria and a blue-green alga, *Cyanidium caldarium* only being present there.

284. Physiologische Untersuchungen über die Veränderung der Membranstoffe an den höheren Pflanzen mit besonderer Berücksichtigung der Verholzung. II. Über die tägliche Veränderung des Zellulosegehaltes in den Blättern, und die „Zellulosemethode", eine neue Methode als Indizium des Stoffgehaltes in den Pflanzen. (Japanisch m. deutsch. Zfg.). Teru FUJITA. (B.S., F.T., K.I.U. **9**, 1940, 49–64).

Es wurde zuerst die tägliche Veränderung des Zellulosegehaltes von ausgewachsenen Blättern von 5 Krautpflanzen untersucht. Dabei wurde der Zellulosegehalt hauptsächlich durch die KÔKETSUsche Pulvermethode bestimmt. Dass der Zellulosegehalt im Blatt während eines Tages wenig schwankt, wurde dabei nachgewiesen. Daher ist es sehr wahrscheinlich, dass wir diesen Stoff zweckdienlich als Standard-Wert zum Vergleich des Stoffgehaltes oder Funktionsgrades in den Blättern anwenden können.

Um diese Vermutung zu prüfen, wurden die täglichen Veränderungen des Wasser-

und Trockensubstanzgehaltes an den Blättern sowohl durch den Wert pro Einheit Zellulose als auch durch die Pulvermethode, und ferner durch die prozentualen Angaben auf das Frisch- und Trockengewicht studiert. Die Ergebnisse, gefunden durch die Zellulosemethode, stimmen zwar mit den durch die Pulvermethode gefundenen überein, und dadurch wurde ohne Zweifel festgestellt, dass die Zellulose zweckdienlich benutzt werden kann, als Standard-Wert für den gewünschten Vergleich. R. KÔKETSU.

285. Physiologische Untersuchungen über die Veränderung der Membranstoffe an den höheren Pflanzen mit besonderer Berücksichtigung der Verholzung. III. Verbreitung der Membranstoffe und der Verhärtungsgrade in den Pflanzen. (Japanisch m. deutsch. Zfg.). Teru FUJITA. (B.S., F.T., K.I.U. **9**, 1940, 219–234).

Die Verbreitung der Membranstoffe und der Verhärtungsgrad zwischen jungen und alten gleichartigen Organen und auch zwischen verschiedenen Organen von 3 Pflanzenarten wurden festgestellt. Die Analyse-Methode, welche der Verf. in der ersten Mitteilung dieser Untersuchungen beschrieben hat, wurde hierbei benutzt. Der Gehalt an den untersuchten Membranstoffen wurde hauptsächlich durch die Pulvermethode von KÔKETSU, aber auch durch die prozentualen Beziehungen auf das Frisch- und Trockengewicht bezeichnet.

Zum Vergleich des Verhärtungsgrades an den Geweben und Zellmembranen, hat der Verf. folgende 4 Verhärtungsgrade an den Geweben und Zellmembranen, aufgestellt: (1) der Gesamtgehalt an Zellulose und Lignin, gefunden durch eine prozentuale Beziehung auf das Frischgewicht, d.h. der Verhärtungsindex der Frischsubstanz, (2) derselbe, gefunden durch die prozentuale Beziehung auf das Trockengewicht oder (3) durch den Wert pro Einheit Pulvervolumen der Trockensubstanz, d.h. die Verhärtungsindexe der Trockensubstanz, (4) derselbe, gefunden durch die prozentuale Beziehung der gesamten Membranstoffe (die Gesamtheit an Pektinstoff, Hemizellulose, Zellulose und Lignin), d.h. der Verhärtungsindex der Zellmembran.

Nach den Ergebnissen der Analyse, war der Pektinstoffgehalt grösser in jüngeren Geweben oder Organen als in älteren; aber der Gehalt an Hemizellulose, Zellulose, Lignin und Gesamtmembranstoffe stand im umgekehrten Verhältnis. Der Verhärtungsindex der Frischsubstanz, der Trockensubstanz und der Zellmembran waren alles grösser in Geweben, Organen oder Zellmembranen, die von einem höheren Zustand der Entwicklung waren. R. KÔKETSU.

286. Über die erfolgreiche Anwendung der Pulvermethode als Indizium für den Verhärtungsgrad der Trockensubstanz bei Pflanzen. (Japanisch m. deutsch. Zfg) Teru FUJITA. (B.M.T. **54**, 1940, 413–421).

Der Verhärtungsgrad der Trockensubstanz des Pflanzenmaterials kann sowohl durch den Wert des Gesamtgehaltes an Zellulose und Lignin, gefunden durch den Wert pro Einheit Pulvervolumen der Trockensubstanz oder durch die prozentuale Beziehung auf das Trockengewicht bezeichnet werden. Aber es ist fraglich, welche Data der beiden Ausdrücke als Indizium für den Verhärtungsindex der Trockensubstanz zweckmässiger ist. Da die Verhärtung der Trockensubstanz der Pflanzen ursprünglich auf dem Verhärtungsgrad der Zellmembran beruht, muss der Wert des Verhärtungsgrades der Trockensubstanz je näher, desto besser im Vergleich mit dem Wert des Verhärtungsindexes der Zellmembran sein, welcher durch den Gesamtgehalt an Zellulose und Lignin, gefunden durch die prozentuale Beziehung der gesamten Membranstoff (die Gesamtheit an Pektinstoff, Hemizellulose, Zellulose und Lignin) gegeben werden kann.

Nach den Resultaten dieser Arbeit, die die genannte Frage zu lösen ausgeführt wurde, waren die Ergebnisse, gefunden durch die Einheit-Volumen Gewebepulver der Trockensubstanz näher den Wert des Verhärtungsindexes der Zellmembran, als die bezogen auf den Prozentsatz des Trockengewichtes. Daraus ist so zu schliessen, dass die Pulvermethode eine bessere Methode ist als die Trockengewichtsmethode, die überdies noch einen anderen Angabefehler hat, welcher durch die Verschiedenheit des spezifischen Gewichtes der zu vergleichenden Materialien bedingt ist. R. KÔKETSU.

287. Further studies on the dwarf disease of rice plant. Teikichi FUKUSHI. (J. F.A., H.I.U. **45**, 1940, 84-154, 2 pls., 1 text-fig. and 9 diagrams).

Almost all important data contained in this paper have already been published in preliminary form from time to time (cf. this JOURNAL **7**, (3), No. 9, (33), No. 125; **8**, (3), No. 6, (41), No. 159; **9**, (102), No. 341, **10**, (36), No. 136). In this paper, however, the method of experimentation, and a series of experiments with their respective results are described in full details, so that those especially interested in the matter should consult the original.

The author's consideration, whether or not the virus will multiply itself within the body of the leafhopper, *Nephotettix apicalis cincticeps* will be briefly referred to below. Concerning whether the virus causing the curly top of beet will be able to multiply within the body of the insect *Eutettix tenellus* the opinions are divided among the investigators: some are inclined towards the positive view, basing on the fact that the infective ability of the insect may be retained undiminished for a long time, while others deny it on account of their observations that after a number of infections the virus content decreases gradually. The present author's view in this matter in respect to the virus of dwarf disease of rice plant may be briefly stated as follows. A certain leafhopper, for instance, which remained non-infective during 30 days after hatching, was observed thereafter to infect 65 healthy plants and retained its infective power during 88 days; 30 non-infective days after hatching just quoted may be the time, during which the virus is concerned in its multiplication. This and several other instances of kindred nature have led the author to the view that the virus in this case is provided with the power of self-multiplication.

Another remarkable fact will be mentioned below. The offspring derived from both non-viruliferous male×female parents as well as those from non-viruliferous female× viruliferous male parents are equally free from the virus, but it is remarkable that the offspring of the latter kind have a greater ability to acquire and transmit the virus in comparison to those of the former. This curious fact the author tries to explain by assuming a special character "affinity" towards the virus which is inherent in certain individuals, and might be due to the action of one or more dominant hereditary factors possessed by them. The author assumes further that the virus will be unable to multiply at all in the absence of such factors.

288. Nucleolar chromosome in the genus *Paris*. (Japanese). Tutomu HAGA. (B. Z. **8**, 1940, 1769-1771, 5 text-figs.),

In *Paris tetraphylla* and *hexaphylla* (n=5) we observe among others the so-called D-chromosome carrying a trabant, and in such case the nucleolus lies at the place of the thread connecting them. In the prophase of pollen nuclear division of both species of *Paris* above cited the author has observed the nucleolus which is attached to the short arm of the D-chromosome. In respect to the root-tip cell he has counted two and three nucleoli in the diploid and triploid individual respectively. In the diploid individual of *P. hexaphylla* he has found a pair composed of one trabant-carrying and

another non-trabant-carrying D-chromosome. After the reduction division which goes on quite regularly the nuclei with the trabant-carrying and the non-trabant-carrying D-chromosomes were produced in equal number. Further, in the paired D-chromosome provided with a trabant the latter and the connecting thread in the one are superior in size than in the other.

289. A critique on the conception of the genom. (Japanese with English résumé). Tutomu HAGA. (J.J.G. **16**, 1940, 211–227, 5 text-figs. and 5 tables).

In the present paper, the problems of differentiation and homology-relationship of the genoms are reviewed and the following conclusions are tentatively given.

Meiotic chromosome pairing between two genoms which are in 'intimate' homology is nearly complete, the modal class of number of pairing per nucleus corresponding to the basic chromosome number (n), while in the case of 'remote' homology the number of pairing is considerably variable, the modal class varying in different cases (n—0). As a general rule it will be stated that the increase in the degree of genetic differentiation decreases the quantity of the meiotic chromosome pairing in proportion to the grade or quantity of the genetic differentiation. Then the relative grade of genetic differentiation will be expressed, though roughly, as reversed to the quantity of the meiotic chromosome pairing.

More or less serial variation in the quantity of the meiotic chromosome pairing is recognizable in a series of diploid hybrids in many plants, such as *Aegilops*, *Triticum*, *Gossypium*, etc. (Cf. KIHARA 1937, SKOVSTED 1937, etc.). This supports the inference that genetic differentiation will point, though superficially, to a property of a continuous series in this respect.

Thus it is probable that the so-called 'homologous' or 'non-homologous' relation determined by the chromosome pairing does not imply anything like 'intimate' or 'remote' genetical relation respectively. Only the 'identical' relationship in strictly genetical sense will be absolute. This consideration naturally leads to the nullification of the critical boundary between auto- and allo-polyploidy. Further this suggests that, as a matter of fact, the principle of the genom analysis is applicable only between the genoms which are in remote homology.

Certain differentiation as a whole of two or more sub-genoms in an allopolyploid would eventually lead to the formation of a new genom, which is no longer divisible into the ancestral genoms. The new genom is polyploid in chromosome number but functionally diploid. In the light of the recent investigations it seems quite probable that the secondary polyploidy is an evolutionary product. Therefore genoms of certain organisms may be composed of secondarily balanced non-polyploidal set as in *Brassica* (cf. HAGA 1938).

Consequently the genom may be comprehensible merely as a set of chromosomes which represents a genetic basis as a whole of an organism. In other words, it may represent an unit as a whole—individual chromosomes being componental units—for the genetic diversity or evolution. Just as in 'species,' the diversity of differentiation, as mentioned above, is too divergent and too complex to be defined in such a simple definition as those given by the previous workers. Author.

290. Diagnostic study on the properties of the albumen crystals found in latex from the tissues of the *Rhus* plants found in Japan. (Japanese with English résumé). Morisige HARADA. (B.S., F.T., K.I.U. **9**, 1940, 7-18, 1 pl.).

In all Japanese species of the genus *Rhus* albumen crystals are contained in the latex, abundantly in that of leaves and young stems, and scantily in that of roots.

They are spear-shaped, conical, or rectangular, or rarely polygonal. The latex of *Rhus succedanea*, *silvestris*, *vernicifera*, *Toxicodendron* var. *vulgaris*, and *trichocarpa* which are poisonous contains numerous small crystals, while the non-poisonous latex of *R. semi-alata* var. *Osbeckii* is characterized by containing a few extremely huge crystals

291. On the macroscopical and microchemical property of the latex exuded from the cross section of the *Rhus* plants found in Japan. (Japanese with English résumé). Morisige HARADA. (B.S., F.T., K.I.U. **9**, 1940, 135–147).

Though the quantity of latex exuded from young stems and leaves is nearly similar in various Japanese species of the genus *Rhus*, it is somewhat different in old stems of its different species, inasmuch as it is very abundant in *R. vernicifera*, pretty so in *R. semialata* var. *Osbeckii*, and far less so in *R. succedanea*, *silvestris*, *Toxicodendron* var. *vulgaris* and *trichocarpa*.

The colour of the latex is different in different species and different parts of one and the same species. For instance, it is white in young stems and leaves of *R. semialata* var. *Osbeckii*, but pale yellow in its old stems. The latex from old stems of *R. vernicifera* is ash-white. In other species it is colourless or light brown. The latex of *R. semialata* var. *Osbeckii* will not easily change its colour in air, and is characterized by its intense viscosity and the rapidity of solidification. In other species the latex becomes soon black in air, is not so viscous and does not so rapidly solidify.

Though the latex is generally acid in its reaction, it is neutral in *R. semialata* var. *Osbeckii*. Further, the latex exuded from old stems contains some caoutchouc, albumen, urusiol or a substance similar to it, and oxidase. Urusiol or the substances similar to it act as a poison and may protect the plant against animals and the caoutchouc may serve for healing injured portion of the plant.

292. Contributiones ad dendrologiam nipponiae australis (VI). (With Japanese résumé). Sumihiko HATUSIMA. (J. Jap. B. **16**, 1940, 527–534).

The following plants are fully described:

Melicopa Awadan (MATUSIMA) OHWI et HATUSIMA comb. nov., *M.* (?) *Sanehārae* HATUSIMA sp. nov., *Tilia rufo-villosa* HATUSIMA sp. nov., *Vitis austrokoreana* HATUSIMA sp. nov., *V. Choii* HATUSIMA sp. nov., *Viburnum kiusianum* HATUSIMA sp. nov.

293. Notes on a new spotted bamboo "Yôrakumontiku" caused by *Lembosia tikusiensis*. (With Japanese résumé). Zyun HIDAKA. (A.PP.S.J. **10**, 1940, 150–153, 2 pls.).

In certain parts of Kyûsyû the author has found the culms of *Phyllostachys nigra* which are beautifully spotted. This is caused by a new fungus growing in a certain place of Kyûsyû, to which the author has given a new name *Lembosia tikusiensis*. The spotted bamboo is called in Japanese "Yôrakumontiku" by the author. The diagnosis of this new fungus is given.

294. *Trichoderma* parasitic on sclerotial fungi. (Japanese with English résumé). I. HINO and S. ENDÔ. (A.PP.S.J. **10**, 1940, 231–241).

Trichoderma viride (*T. lignorum*) which lives parasitic on the sclerotia and mycelia of certain sclerotial fungi often does serious damage, so as to lead them to death. This fungus may be also parasitic on sweet potato and other crops. Since the injury done to such crops is very slight as compared to that done on sclerotial fungi, it may be profitably used as a controlling agent for destroying the sclerotial disease.

295. Studies on the parasitism of the rust of *Acacia confusa* MERRILL, *Maravalia hyalospora* (SAW.) DIET. III. A cytological study of different regions of phyllodes with varying degrees of resistance to urediospores-infections. (Japanese with English résumé). Seiichi HIRANE. (A.PP.S.J. **10**, 1940, 171–185, 2 pls.).

When the infection of the phyllodes of *Acacia confusa* by the rust, *Maravalia hyalospora*, takes place, the result is different in different parts of one and the same phyllode

Even in the young growing portion of the phyllode we may distinguish susceptible and immune regions. In the former the hypha evolved from the appressorium enters within through the stomata or directly through the cuticle; then a substomatal vesicle is formed, which gives rise to primary hyphae. They pass through the palisade and spongy tissues, in the latter of which many haustoria are produced till the time of the teliospore formation. The plastids in the palisade cells, though at first reduced in size and function, gradually become larger and more greenish, and increase in number.

In the immune region, though the invading hypha produces the vesicle as in the case of susceptible region, no further development of the parasite occurs and it dies soon after.

On mature, fully grown portion of the phyllode which is immune to the attack of the fungus, the latter is able to enter the host and to develop to some extent, though soon the development comes to end.

296. Materials for a rust flora of Kiushu. Naohide HIRATSUKA. (T. S. N. H. S. **16**, 1940, 139-146).

The following rusts are enumerated: *Uredinopsis* (1 sp.), *Milesina* (3, incl. *M. chikugoensis* and *M. miikensis*, both sp. nov.), *Melampsoridium* (1), *Pucciniastrum* (5), *Thekopsis* (2), *Melampsora* (2), *Phakopsora* (3), *Chrysomyxa* (1), *Coleosporium* (2), *Kuehneola* (2), *Blastospora* (2), *Triphragmidium* (1), *Pileolaria* (1), *Hamaspora* (1), *Uromyces* (3), *Puccinia* (21).

297. Materials for a rust flora of Riukiu Islands, II. (With Japanese résumé). Naohide HIRATSUKA. (B.M.T. **54**, 1940, 373-378, 1 text-fig.).

The following species of rusts are enumerated: *Hyalospora* (1 sp.), *Coleosporium* (1), *Hemileia* (1), *Skierka* (1), *Uromyces* (1, *U. Tairae* HIRATSUKA fil. sp. nov.), *Puccinia* (10), *Aecidium* (1), *Uredo* (4).

298. Miscellaneous notes on the East Asiatic Uredinales with special reference to the Japanese species. (With Japanese résumé). Naohide HIRATSUKA. (J. Jap. B. **16**, 1940, 613-617).

The following species are contained: *Milesina* (2 sp.), *Hyalospora* (1, *H. Diplazii* sp. nov.), *Pucciniastrum* (2, incl. *P. Crawfurdiae-japonicae* sp. nov.), *Thekospora* (3 incl. *T. nipponica* sp. nov.). *Phakopsora* (1), *Chrysomyxa* (2), *Cerotelium* (1), *Kuehneola* (1), *Aplospora* (1).

299. Uredinales collected in Korea, IV. (With Japanese résumé). Naohide HIRATSUKA. (B.M.T. **54**, 1940, 427–433).

The following species of Uredinales are contained: *Pucciniastrum* (2), *Thekopsora* (2), *Melampsora* (5), *Phakopsora* (1), *Chrysomyxa* (1), *Coleosporium* (4), *Gymnosporangium* (1), *Uromyces* (1), *Puccinia* (14), *Rostrupia* (1), *Aecidium* (3).

300. A new species of *Pucciniastrum* on *Acer rufinerve*. (With Japanese résumé). Naohide HIRATSUKA. (A.PP.N.J. **10**, 1940, 154-155).

Pucciniastrum hikosanense HIRATSUKA fil., sp. nov. is described.

301. Studies on *Uromyces lespedezae-procumbentis* in Japan. (With Japanese résumé). Naohide HIRATSUKA. (T.T.S.A.S. 7, 1940).

21 species of *Lespedeza* were found by the author to be the hosts of *Uromyces lespedezae-procumbentis* (SCHW.) CURTIS. Inoculation experiments executed by him have led to his discovery of three following specialized forms, viz. f. sp. *Macrolespedezae*, f. sp. *Lespedezae-pilosae*, and f. sp. *Lespedezae-cuneatae*. The hosts of each form are noticed.

302. Nuntia ad floram japoniae. XLIII. (With Japanese résumé). Masazi HONDA. (B.M.T. **54**, 1940, 467-468).

The following varieties and forms are new: *Deutzia crenata* S. et Z. forma *purpurina* HONDA, *Astilbe odontophylla* MIQUEL forma *rosea* HONDA, *Veronica peregrina* L. var. *pubescens* HONDA, *Potentilla stolonifera* LEHMANN var. *lancifolia* HONDA, *Clematis stans* S. et Z. forma *rosea* HONDA, *Trichosanthes cucumeroides* MAX. var. *globosa* HONDA.

303. Acidity of the substrata of Japanese Bryophytes. Yoshiwo HORIKAWA. (P.I.A. **16**, 1940, 306-308).

The pH of the habitats of the Hepaticae and Musci was studied by collecting about 1000 bryophytic substrata from various parts of Japan and also from Mantchukuo. The pH-determination was done either colorimetrically or electrometrically. The substrata were also treated with 10% HCl to test their calcium carbonate contents. The results are shown in an extensive table. The pH lies between 4.1–8.0, only 1 case lying between 3.0–3.5 being found.

304. Materials of the botanical research towards the flora of Micronesia (XIX). Takahide HOSOKAWA. (J. Jap. B. **16**, 1940, 535-545).

A certain number of species from each of the following families are enumerated: Hymenophyllaceae, Schizacaceae, Cyatheaceae, Polypodiaceae, Flagellariaceae, Triuridaceae, Burmanniaceae, Icacinaceae, Hippocrateaceae, and Styracaceae.

305. Species generis *Euphorbiae* Imperii japonici (II)-(IV). I. HURUSAWA. (J. Jap. B. **16**, 1940, 391-400, 447-461, 507-516, 571-582, 633-645, altogether 41 text-figs.).

Sec. Esula, new subsec. Euesululae is established, which contains 7 species, together with some new varieties, etc. Among them *Euphorbia Nakaii* is a new species and described in detail. Sec. Esula subsec. Galarrhoei (BOISSIER) contains 3 ser. and 6 species altogether, with a number of new varieties, etc. The following are new species: *E. barbellata*, *E. subulatifolia*, *E. Imaii*, *E. hakutosanensis*. A number of keys for the identification of species are given.

306. A new anthracnose of jute-plant. (Japanese with English résumé). S. IKATA and M. YOSHIDA. (A.PP.S.J. **10**, 1940, 141-149, 6 text-figs.).

A new fungus, *Colletotrichum corchorum* IKATA et TANAKA, nov. sp. was observed to invade the stems, leaves and pods of *Corchorus capsularis*. The inoculation experiments gave positive results. Incubation period about 3 days, optimum temperature for the growth of the fungus 30°C. The disease is seed-borne, for the mycelium exists in the seed, and the spores are adhering to its external part.

307. Studies on the genus *Hymenochaete* of Japan. (Japanese with English résumé). Rokuya IMAZEKI. (B.T.S.M. No. **2**, 1940, 22 pp., 5 pls.).

The genus *Hymenochaete* LÉVEILLÉ which is characterized by the even hymenophore, brown context and brown setae in the hymenium was established by separating from *Stereum* and *Corticium* of the Telephoraceae in FRIES' system. PATOUILLARD placed it in his "Série d'Igniaires," and DONK established for it a special subfamily Hymenochaetoideae. Though the author agrees with the views of PATOUILLARD and DONK he treats the genus as belonging to the family Corticiaceae. The genus contains three sections, Stipitae, Apodes and Resupinatae, all three having been established by SACCARDO.

No species of the first section is found in Japan. The following noteworthy species from the two other sections are enumerated: *Hymenochaete Yasudai* IMAZEKI, *H. rufomarginata* IMAZEKI, *H. attenuata* LÉVEILLÉ, *H. intricata* LLOYD, *H. adusta* (LÉV.) BRES., *H. Mougeotii* (FR.) CKE, *H. tuberculosa* CKE.

308. Meiosis in *Thea sinensis*. I. Caucasus tea. (Japanese with English résumé). Tyoyo INOUE and Sigebumi ARIMA. (P.C.S.S.J. **12**, 134–139, 16 text-figs.).

This paper treats of the reduction division of PMCs in Caucasus tea. Its important part relates to the relation between the nucleolus and the chromosomes. The authors say: "During the first telophase the nucleolus is formed from the chromatin of the chromosomes, which concentrates gradually to form a mass of spherical shape. But during the second prophase the spireme seems to reform the chromosomes, gradually receiving the chromatin from the nucleolus. Again, in the second telophase...the chromatin of the chromosomes concentrates to form the nucleolus." In Caucasian tea n=15.

309. On the branching of some araliaceous plants with special reference to the behaviour of the ramular trace bundles. Riukiti INOUYE. (Jap. J.B. **11**, 1940, 193–212, 1 pl. and 15 text-figures).

310. Ecological studies of the peat bog (2). The peat bog of Digokunuma. (Japanese with English résumé). E. IWATA. (E.R. **6**, 1940, 207–226, 9 text-figs. and 9 tables).

Digokunuma is the name given to the peat bog in Mt. Odake at an elevation of ±950 m. Three plant communities may there be distinguished, viz. (1) the bog plant community, the nucleus of the bog, (2) the scrub on the periphery of the bog, and (3) primary community due to the topographical condition.

The bog plant community contains *Sphagnum-Salix Reinii* community, *Phragmites communis* community, *Phragmites communis-Salix Reinii* community, and *Salix Reinii* community. The scrubs on the periphery contain *Acer Tschonoskii* community and *Acer Tschonoskii-Salix Reinii* community. The primary community due to the topographical origin may be divided into *Betula Ermanni* var. *communis* community, *Sasa kurilensis* community, *Reynoutria sachalinensis* community and *Miscanthus sinensis* community.

311. Studies on the penetration of *Peronospora Aparines* (DE BARY) GÄUM. and the reaction of the epidermal cell. (Japanese with English résumé). Yosito IWATA. (A.PP.S.J. **10**, 1940, 203–213, 6 text-figs.).

The inoculation by the conidia of *Peronospora Aparines* has given positive results in several cases. The appressoria were found to be formed at the boundary line of

the epidermal cells in the leaf under-surface, whether the infection hypha produced from them is able to penetrate then into the host or not. In the former case, the hypha developed from the appressorium penetrates intercellularly into the host through the boundary line of epidermal cells, rarely through stomata or even directly. Haustoria which are then developed are sent out into the epidermal cells.

312. High temperature treatment in *Triticum* and the character and the chromosomes in the next generation. (Japanese). Fuyuwo KAGAWA. (P. C. S. S. J. **12**, 1940, 90-93).

Potted plants of *Triticum compactum* which have just finished their pollination were placed in a warm chamber, 45–50° and 43°, during 40 and 30 minutes respectively, and then replaced under natural condition. Seeds obtained from such plants were sown and the offspring therefrom were examined. Anomalies were observed about them, either chimeras or polyploids.

The chimerical plant is so called, because it produces both normal and anomalous panicles. The former are distinguished by their slender shape, and the adventitious root at the base of the culm bearing such panicles were shown on karyological examination to possess 2n=28. The panicles intermediate in shape between slender form and normal were also found.

The fertility of anomalous panicles above cited is very low or even they are wholly sterile.

Besides anomalous panicles those which are apparently normal were produced. Their fertility is the same as in normal panicles, but the grains are smaller, and in one case their germination rate was considerably lower than in normal panicles.

As regards the heteroploid offspring one case was observed, where the 2n number is 33 and PMC has shown $13_{II}+7_{I}$. This plant was in several respects larger than the normal one, though their fertility was much lower than in the latter. In another case with 2n=34, the plant is distinguished by its glumes which are red-tinged throughout their whole surface.

The high temperature experiment was tried by the author concerning a strain of *T. vulgare*, but no single anomalous plant was obtained.

313. Vegetation in the area around "Sin'yu" hot springs on Mt. Hakkôda. (Japanese with English résumé). Takumi KAGAWA. (E.R. **6**, 1940, 227-247, 297-317, 19 text-figs., 16 tables).

The vegetation on the area around the hot spring Sin'yu on Mt. Hakkôda was studied with special reference to the influence of the nature of hot springs on the vegetation. In this area there are hot springs of various pH-concentrations and various temperatures. There at least five plant-associations may be distinguished, viz. (1) *Phragmites-*, (2) *Polygonum japonicum-* (3) *Miscanthus sinensis- Hydrangea paniculata-*, (4) *Miscanthus-* and (5) *Arthraxon ciliare-* association. Among these five kinds of associations, concerning (4) and (5) which establish themselves near the hot spring of neutral or alkaline reaction, the pH-concentration of soil was found to be 7.6–7.4 (average) at the depth of 0–5 cm, while in (3) and (4) near the hot spring of acid reaction the pH of soil was 5.1 and 5.3 respectively at the same depth. The influence of temperature and humiidty of soil should also be considered in studying the vegetation. The soil where the associations (3) and (5) are established is warmer than that of the associations (1), (2) and (4) (32.8° and 35.8° on one hand against 29.6°, 26.9° and 16.3° on the other respectively at the depth of 5 cm). In respect to the humidity of soil, to cite two extreme cases of its water content the average % (dry weight) is 62.7 and 867.3 in (4) and (1) associations respectively.

The region just above indicated is surrounded by deciduous broad-leaved forest, chiefly consisting of *Fagus crenata* with dense undergrowths. It is remarkable that here no influence of hot spring is recognizable.

314. Studies on the cultural experiments on the fern rusts of *Abies* in Japan I-II. Senji KAMEI. (J.F.A., H.I.U. **47**, 1940, 1–191, 6 pls. and 7 text-figs.).

The fir-trees. such as *Abies Mayriana, A. sachalinensis*, etc. are widely distributed in Hokkaido as important forest trees, and commonly associated with numerous species of ferns growing as undergrowth in forests and which are often rusted, *Adiantum, Athyrium, Dryopteris, Thelypteris, Pteridium, Matteucia*, etc. The present memoir contains the results of the author's extensive inoculation experiments executed during 15 years concerning the heteroecism relation between certain species of *Abies* and certain species of three genera of rusts, *Uredinopsis* (9 sp.), *Milesina* (6 sp.) and *Hyalospora* (1 sp.).

Artificial inoculation of the *Abies* needles with the basidiospores, uredospores, and amphispores, if any, taken from fern fronds was performed and the appearance of spermogonia and aecidia (*Peridermium*) was observed in many cases. That of fern fronds with aecidiospores was also done, and the appearance of uredo- and teleutospores was ascertained in several cases.

Below a few important data from the paper will be cited. Spermogonia are either subcuticular or subepidermal. The latter of *Uredinopsis* and *Milesina* do not differ very much from each other, while subcuticular ones of *Uredinopsis* were much smaller and more superficial than those of *Milesina*.

The inoculation experiments have revealed that though the species of *Milesina* and *Uredinopsis* are not strictly restricted to any particular species of *Abies*, they are strictly limited to particular species of ferns. To cite one instance, the inoculation of *Milesina exigua* was equally successful in *Abies Mayriana, A. sachalinensis* as well as in *A. firma*, while, on the contrary, the aecidiospore inoculation of *Milesina Itôana* which was successful in the case of *Dryopteris crassirhizoma* did not lead to the development of uredospores in four other ferns (1 sp. of *Scolopendrium* and 3 sp. of *Polystichum*).

So far as it may be concluded on the basis of the results of the author's artificial inoculation experiments, it will be seen that between the germination of teleutospores which have overwintered on one hand and their new formation through the aecidiospore infection on the other a little more than two months intervene. In *Hyalospora aculeata* it was ascertained that the whole life cycle is completed within one season, and this fact will stand in sharp contrast to what is known about *Hyalospora Aspidiotus* which is said to require four years for the completion of its life cycle.

The amphispores are developed in *Uredinopsis*, and their germination was observed in *U. filicina* and *U. Struthiopteris*. The overwintering is often accomplished in *Uredinopsis* by means of amphispores. In *Milesina*, however, which lacks the latter, and where besides the uredo- and teleutospores are formed on old fronds in the next spring, it is probable that the hibernation is performed by means of mycelia in the tissues of affected fronds.

For all other details in this paper, cf. the original.

At the end of the paper a list of cited literature containing 138 Nos. is appended.

315. Studies on the genus *Valonia* from Palao. (Japanese). Tiyoiti KANDA. (Sc. S.S.I. **3**, 1940, 107-116, 8 text-figs.).

Some observations on *Valonia fastigiata* HARV., *V. Ægagropila* C. AG., *V. ventricosa* J. AG. growing in Palao Isl. under Japanese Mandate, were done.

V. fastigiata is made up of a number of coenocytic vesicles which are arranged somewhat parallel to each other. The vesicles are firmly connected to one another by means of the fibula which consists of a number of small drum-shaped bodies arranged in a circle. Each vesicle is characterized by its intense turgidity. For the new production of the vesicle a lens-shaped body issues out from the parent vesicle and grows gradually to form a daughter-vesicle. In *V. Ægagropila* the fibula is imperfectly developed, and consequently the vesicles are apt to separate from one another. *V. ventricosa* which is a single spherical or oval-shaped body with pH=6.2–6.4 measures 7×10.5 cm which surpasses considerably in size that seen hitherto by various authors in this species.

No reproductive organs are yet seen by the author in all three species just noticed.

316. A summary of our knowledge of Papuan *Pandanus*. (With Japanese résumé). Ryôzô KANEHIRA. (B.M.T. **54**, 1940, 249–260, 9 text-figs., 281).

According to the author the genus *Pandanus* is represented at present in New Guinea by 42 species and 3 varieties. All of them are enumerated and described with illustrations, of which the four following are new species, viz. *P. orculaeformis*, *P. Inokumae*, *P. permicron*, and *P. pseudosyncarpus*.

317. On "Ais", an oil-yielding plant from Micronesia. (Japanese). Ryôzô KANEHIRA. (J. Jap. B. **16**, 1940, 471–475, 4 text-figs.).

"Ais" is a vernacular name for *Parinarium glaberrimum* HASK. in Ponape and Truck Island. It is described in detail and illustrated in this paper. It is generally a tree of medium dimension and grows in various islands of Micronesia, i.e. Palao, Yap, Truck, Ponape, Kusaie. The preparation of oil from fleshy cotyledons and its use are mentioned.

318. On *Eurycorymbus Cavaleriei* (HANDEL-MAZZETTI) REHD. (Japanese). Ryôzô KANEHIRA. (J. Jap. B. **16**, 1940, 476–479, 5 text-figs.).

Detailed description of *Eurycorymbus Cavaleriei*. Longitudinal and cross sections of its wood are figured at 200 times magnification.

319. Studies on *Gymnosporangium Haraeanum* SYD. 1. Its heterothallism. (Japanese with English résumé). Eikichi KAWAMURA. (A. PP. S. J. **10**, 1940, 84–91, 3 text-figs.).

Gymnosporangium Haraeanum is a polyxenous heteroecious species which lives on the pear and the juniper.

The author has executed the infection by sowing its sporidia on pear leaves and observed always the development of spermogonia which are characterized by excreting the nectar containing the spermatia. When such infections are isolated, aecidia were never developed, but when the nectar from one spermogonium is transferred to some other, the formation of aecidia takes place. The conclusion derived from the observation of such facts is that the fungus under discussion is heterothallic and any sporidial infection must be supplied with the spermatia of the opposite sex in order to see the aecidia development.

320. Symbolae iteologicae VIII. Arika KIMURA. (Sc. Rpts., T.I.U. **15**, 1940, 401–418, 7 pls. and 7 text-figs.).

The following plants belonging to the family Salicaceae are either enumerated or described: *Salix Kinuyanagi* KIMURA sp. nov., *S. Kingoi* KIMURA sp. nov., f. *hebecarpa* KIMURA f. nov., f. *macrocataphylla* KIMURA f. nov., ×*S. Koiei* hyb. nov., ×*S. thaymasta* KIMURA, ×*S. ampherista* SCHNEIDER var. *eriocarpa* KIMURA, *S. vulpina* ANDERSSON, *S. pulchroides* KIMURA, *S. melanostachys* MAKINO, *S. integra* THUNB., *S. japonica* THUNB., *S. nco-fuscata* KIMURA nom. nov., *Balsamiflua Denhardtiorum* (ENGLER) KIMURA comb. nov., *S. pentandra* L. subsp. *pseudopentandra* FLODERUS.

321. On a method of varietal resistance trials of sugar cane to red rot. (Japanese with English résumé). Tomijiro KIRYU. (A. PP. S. J. **10**, 1940, 156–170).

The degree of resistance of several sugar cane varieties against red rot caused by *Colletotrichum falcatum* WENT was studied as follows:

As the inoculum the fungus culture at 28° C for 4 days on cane sugar juice was employed. The inoculation was done by inserting a small portion of the fungus culture into the hole made in the center of the interior of the cane stalk. At the harvest time the inoculated stalks were split lengthwise and the size of affected tissues was measured. From this size as well as from the number of internodes affected during the time passing from the inoculation till the harvest the degree of disease resistance of various varieties was judged. The results of the author's experiments are shown in a table.

322. Expositiones plantarum novarum Orientali-Asiaticarum 5. (Japanese with Latin diagnoses). Siro KITAMURA. (A. PT. G. **9**, 1940, 111–118).

The following plants are enumerated or described: *Artemisia Kobayashii* sp. nov., *Saussurea firma* (KITAGAWA) KITAMURA comb. nov., *Cacalia cuneata* (HONDA) KITAMURA comb. nov., *Olgaea tangutica* ILJIN, *Cirsium Leo* NAKAI, *Ixeris chinensis* NAKAI subsp. *versicolor* KITAMURA, *I. tamagawaensis* (MAKINO) KITAMURA comb. nov., *I. nikoensis* NAKAI, *I. dentata* subsp. *stolonifera* (KITAMURA) KITAMURA comb. nov., *Ligularia Fischerii* (LEDEB.) TURCZ., *L. Taquetti* (LÉVEILLÉ et HARIOT) NAKAI, *L. angusta* (NAKAI) KITAMURA comb. nov.

323. On the abortive canker-like body on birch from Japan. (Japanese). Yosio KOBAYASI. (J. Jap. B. **16**, 1940, 684–688, 1 text-fig.).

The author has found recently in a certain place of Sachalien the canker-like body breaking out from the bark of *Betula Ermanni*. It is charcoal-black, indeterminate in shape, and measures 10–30 cm in diameter. It is present simply as the sclerotium, and no fructification was seen. It may be *Poria obliqua* (PERS.) BRES.

324. Bambusaceae of Sachalien. (Japanese). G. KOIDZUMI. (A. PT. G. **9**, 1940, 165–191).

At first the history of the studies of the Bambusaceae in Sachalien beginning with those by Fr. SCHMIDT in 1868 is described. The climate and the distribution of the Bambusaceae in South Sachalien are described in next place. According to the author 31 species of the genus *Sasa* are known at present from Sachalien. The genus is divided into 3 sections, and each species belonging to them is described in detail.

Section I. Macrochlamys (6 sp.)
" II. Crassinodi (7 sp.)
" III. Eusasa (18 sp.)

Among 31 species in all 15 were those named by the author, of which the following are new: *Sasa koshinaina, S. lasiniodosa, S. naokateiensis, S. sattosasa, S. stupitans, S. blepharodes, S. fortis, S. intercedens, S. laevissima, S. lingulata, S. okuyezoensis, S. sorstitialis.*

325. Über den Einfluss von Heteroauxin auf das Längenwachstum und die Zellteilung in der Wurzel von *Pisum sativum*. (Japanisch m. deutsch. Zfg.). Hitoshi KOJIMA. (B. S., F. T., K. I. U. **9**, 1940, 18-28).

Der Verf. hat die Wurzelspitze der Keimlinge von *Pisum sativum* in einer Heteroauxinlösung eingetaucht und die dadurch auf das Wurzelwachstum ausgeübten Einwirkungen studiert.

Der Effekt ist nach der Konzentration der Lösungen verschieden. Diejenigen von 10^{-8}–10^{-9} Mol üben keinen Einfluss aus, ebenso wie bei dem Leitungswasser, während diejenige von 10^{-4} Mol das Längenwachstum der Wurzel stark hemmt. Mit der absteigenden Konzentration der Lösungen wird der Effekt allmählich schwächer. Zugleich mit der Hemmung des Längenwachstums tritt die Beschleunigung des Dickenwachstums auf. Das Längen- und Dickenwachstum der Wurzel sind zu denselben der die Wurzelgewebe zusammensetzenden Zellen zuzuschreiben. Im Falle, wo die Zellstreckung gehemmt wird, wird auch die Zellteilung verhindert.

Beim Gebrauch von 10^{-4} Mol Lösung erfolgt die Beschleunigung der Zellteilung im Kambium und Perizykel des Streckungsorganes, wodurch zahlreiche Wurzeln entstehen.

Man kann im allgemeinen sagen, dass das Dickenwachstum der Wurzel unter dem Einfluss des Heteroauxins auf die Zellteilung zurückzuführen ist, aber beim Gebrauch von 10^{-4} Mol Lösung erfolgt ein unregelmässiges Dickenwachstum, welches zur Entstehung des tumorähnlichen Organes führt.

326. On the discrimination of rice varieties by means of coloring reaction of hulled kernels to phenol-fuchsin. (Japanese). Mantarô KONDÔ and Yasusi KASAHARA. (P. C. S. S. J. **12**, 1940, 122-128).

The authors have proposed a method for distinguishing the rice varieties according to the color reaction of their hulled grains towards phenol-fuchsin. The intensity of color reaction is different according to the origin of fuchsin, and this fact must be taken in consideration in the experiments under question.

The color reactions were reddish violet, violet, dark violet, indigo violet in one experiment, while they were thick reddish violet, reddish violet, pale reddish violet, violet in another. In the experiment now under question the principal parts which show the color reaction are the pericarp and the seed-coat, though the perisperm and the aleurone-layer are slightly tinged.

The cause of the coloration seems to lie in the pectin substance contained in the cell-membrane of the pericarp.

327. Nährlösungsverdampfungs- und Rückstandsveraschungsverfahren als Versuchsmethode in Gebiet des Aschenstoffwechsels der Pflanzenphysiologie. Richiro KÔKETSU, Takayuki SIOMI und Yoshifumi ARIGA. (Japanisch m. deutsch. Zfg.). (B.S., F. T., K. I. U. **9**, 1940, 205-218).

Es wurde konstatiert, dass sowohl die Verdampfung der Nährlösungen als auch die Veraschung des Verdampfungsrückstandes meistenfalls mit kleinen Versuchsfehler an den Lösungen von verschiedenen Konzentrationen ausgeführt werden kann, nur vorausgesetzt, dass die Menge des gewonnenen Rückstandes nicht zu klein ist.

Die Menge des Verdampfungsrückstandes einer Nährlösung ist häufig wie erwartet nicht wenig verschieden von der kalkulierten Menge der anorganischen Stoffe in der Lösung. Falls wir die Menge der von der kultivierten Pflanze aus der Nährlösung aufgenommenen Stoffe bestimmen wollen, sind wir deswegen vorzugsweise angewiesen,

die Differenz zwischen den Mengen beider Verdampfungsrückstände erhalten von den Närlösungen vor und nach der Kultur der Pflanzen zu gewinnen.

Das Verfahren der Rückstandveraschung ist auch mit gleichem Zwecke und Erfolge wie das Verfahren der Nährlösungsverdampfung anwendbar. Diese Methode ist sehr zweckdienlich, um den Grad der Stoffaufnahme der Pflanzen aus der Nährlösung im Vergleich mit dem Aschengehalt der Pflanze zu beurteilen. R. KÔKETSU.

328. Various forms of the seed of *Ginkgo biloba*. (Japanese). Takuji KOSHIMIZU. (J. Jap. B. **16**, 1940, 551-552, 2 text-figs.).

The seed of *Ginkgo biloba* is normally ellipsoidal and two-ridged with two symmetrical planes. Size (average of 1500 seeds): 21.26±0.22 long, 15.00±0.18 broad and 11.89±0.28 thick (all in mm).

In abnormal cases the number of ridges for each seed is various, viz. 1, 3, 4, or 5. According to the author's measurement the normal seed with two ridges was found to amount to 91–92% of the whole.

329. Viviparous fruit of *Ardisia japonica* BLUME. (Japanese). Takuji KOSHIMIZU. (J. Jap. B. **6**, 1940, 553, 1 text-fig.).

Besides various mangrove plants, only the three following Japanese plants have hitherto been recorded to be viviparous, viz. *Ardisia hortorum* Maxim., *A. crispa* A. DC., *Podocarpus macrophyllum* D. DON. Recently the author has observed the vivipary in *Ardisia japonica* BLUME.

330. Further studies on the vascular course in the male inflorescence of *Zea Mays*. Vascular anatomy in maize II. (Japanese with English résumé). Masao KUMAZAWA. (B. M. T. **54**, 1940, 307 313).

This paper is a supplement of the author's former publication (cf. this JOURNAL **11**, (16), No. 52).

A number of small vascular bundles which are arranged in a ring at the periphery of the node in the male inflorescence axis of maize are called here "outmost peripheral bundles." They originate from the lower empty glume ("untere Hüllspelze") of one or two spikelets at the end of that axis, and they are easily distinguishable from others.

The medullary bundles found at the top of the male inflorescence are derived from the central bundles of the axis of the uppermost spikelet. Their course follows the so-called the palm-type, inasmuch as these bundles, in moving down the stem, migrate towards the periphery, fuse to each other as well as also with leaf trace bundles, though they do not fuse with the innermost peripheral bundles above cited, except at the base of the stem.

331. On the vascular course of the leaf trace in *Zea Mays*. Vascular anatomy in maize III. (Japanese with English résumé). Masao KUMAZAWA. (B.M.T. 54, 1940, 493-504, 2 text-figs. and 1 graph).

The leaf number in the main axis of maize which is different in different strains is variable under different external conditions, though quite slightly. The course of leaf trace bundles is various. They are sometimes medullary throughout their entire course, while in other cases they run at first in the pith and then sooner or later go to the periphery. Sometimes without entering the pith at all, they fuse with the outermost peripheral bundles. Again in some other cases they go up to the cortical part and soon disappear.

The author could discover the fact that the medullary bundles after descending independently through one or several internodes are combined with the same kind of the bundles in the pith. Such bundles migrate gradually to the periphery, till finally they will fuse with the peripheral bundles at the lowest part of the stem.

The sclerenchymatous tissue protecting the large leaf trace bundle dorsally is left alone in the cortex after the passage of the bundle into the pith. Then a small vascular bundle is newly formed in this tissue, and the whole is connected with the innermost peripheral bundle in the same node.

Some other facts of interest are contained in this paper, for which the readers will consult the original.

332. Chromosomen von *Iris Rossii* BAKER. (Japanisch). Hiidu KURITA. (B. Z. **8**, 1940, 72, 2 Textfig.).

Nach der Verfs. Beobachtung über fixierte und gefärbte Präparate der jungen Blattknospe von *Iris Rossii* 2n=32. Nebenbei wird die Chromosomenzahl einiger anderer *Iris*-Arten nach verschiedenen Autoren zitiert, nämlich, *Iris albopurpurea* n=16, 2n=32, *I. laevigata* var. *hortensis* n=12, 2n=24, *I. sibirica* var. *orientalis* n=15, 2n=28.

333. Studies of mitosis and meiosis in comparison. I. A morphological analysis of meiosis. Yoshinari KUWADA. (Cyt. **11**, 1940, 217-244, 1 text-fig.).

This paper is the introduction to the studies of mitosis and meiosis in comparison. In this analysis of meiosis, the morphological nature of the reduction division is discussed, and supporting FARMER's view on meiosis it is concluded that the meiotic prophase is a double prophase consisting of the prophases of the mitotic and the reduction division, and that some conditions which differ from those in the normal mitosis should cause the chromosome pairing which gives rise to the double prophase or the prolongation of prophase that may upset the time relationship between the chromosome development and the spindle formation, thus resulting in the disjunction of the paired chromosomes instead of the separation of the divided chromosomes and in the occurrence of an extra polar chromosome separation which separates the latter to complete the division. The case of the formation of restitution-nuclei observed by ROSENBERG, the case of the pseudohomotypic division and the cases of *Pygaera* hybrids and *Lomentaria rosea* in European waters are regarded as representing the cases of the reduction and reversion of meiosis to mitosis and the progression to two cycles of mitosis respectively. The author.

334. The genus *Hosta*. Fumio MAEKAWA. (J. F. S., I. U. T., Ser. Botany **5**, 1940, 317-425, 6 text-figs. and 100 photos.).

This monograph of the genus *Hosta* begins with the introductory note, where the difficulties for studying the classification of the genus *Hosta* are noticed. One of them, for instance, is caused by the succulent nature of plants of this genus, which makes the imagination of the living form from dried specimens impossible. Another difficulty lies in their notable local variation, etc. etc.

Then follows the description of the most important characteristics of *Hosta* species for their classification The distribution is also noticed. According to the author's new classification the genus is divided into two subgenera, Niobe and Bryocles. To the former only one species belongs, while the second contains all remaining species, 38 in all and is divided into 10 sections.

Subgenus Niobe is characterized among others by having night flowers, and contains one species, *Hosta plantaginea* (LAMARCK) ASCHERSON.

Subgenus Bryocles contains 38 species, of which the following are new species: *Hosta fluctuans*, *H. montana*, *H. Tokudana*, *H. tosana*, *H. Hippeastrum*, *H. pachyscapa*, *H. tortifrons*, and *H. cathayana*.

335. Observations on some characters of tetraploid rice-plants. (Japanese). Isao MAJIMA. (J. J. G. **16**, 1940, 190–191, 1 text-fig.).

Concerning the hybrids of the rice strains Sinriki×Asahi the comparison of various characters between the hybrid 4x and one of the parents (Asahi) 2x was done. The results are shown in a table. The proportion of the lengths of various organs is 1.00: 1.15 in the di- and tetraploid respectively. The number of stomata per unit area of the leaf is smaller in 4x than in 2x; the same behaviour may be seen in the number of tillers and that of kernels for each panicle.

In comparison to 2x the growth is retarded in 4x. The short day treatment is more effective in 4x than in 2x.

The number of tetravalents seen in PMC was mostly 10. The tetrads are normal in shape, but 30% sterile pollen was present.

All crosses 4x×2x and 2x×4x were unsuccessful, except one case in the former cross, where 2 grains were obtained.

336. Phage-produced resistance strains of *Bacillus aroideae* II. The behavior of the organisms in phage-inoculated sand-cultures. Takashi MATSUMOTO. (T. N. H. S. F. **30**, 1940, 89–98, 5 tables).

The author has some times ago published his work on the so-called resistance strain of *Bacillus aroideae* in the phaged culture solution (cf. this JOURNAL **11**, (17), No. 55). He has thereafter performed certain experiments concerning the behaviour of *Bacillus aroidea* in the phaged sand culture, and the results are enunciated in the present paper.

According to them, not only is the bacteriophage for *Bacillus aroideae* accumulated more abundantly in the phaged sand culture than in phaged liquid medium, but also its activity is maintained considerably longer than in the latter.

The organisms isolated from the sand-culture are yet mostly susceptible to the phaging action, in contrast to those derived from the liquid medium, which are generally the resistance strains.

The great reduction of the multiplication of the organism is observed in the case of phaged sand-culture, just as in that of phaged liquid medium.

Another difference between the phaged sand-culture and liquid medium is that while in the former the pH-concentration remains almost constant (±7.0), in the latter it is shifted to ±5.2.

337. Virus disease of tobacco in Formosa. Takashi MATSUMOTO and Ryosuke TATEOKA. (T. N. H. S. F. **30**, 1940, 197–198).

Some virus diseases seen in Formosa are enumerated: Common mosaic, mild mosaic, type A and B, yellow mosaic, etch, composite disease (mixture of common tobacco mosaic and a certain potato mosaic virus), leaf-curl, etc. The symptoms, etc. are briefly noticed.

338. Induzierte Haploidie und Autotetraploidie bei *Aegilops ovata* L. (Japanisch m. deutsch Zfg.). Seiji MATSUMURA. (B.M.T. **54**, 1940, 404–412, 1 Taf. u. 5 Textabb.).

Aegilops ovata L ♀ ×*Triticum dicoccoides* KÖRN. var. *Kotschiyanum* PERC. ♂ wurde ausgeführt, und 20 Stunden nach der Bestäubung wurde die Behandlung mit 0,01%

Colchicinlösung vorgenommen. Alle Nachkommen waren die F_1-Bastarde (2n=28), ausgenommen eine haploide Pflanze (2n=14), welche durch Parthenogenes entstanden sein mag. Weiter, unter den Samen, welche durch mit 0,05% Colchicinlösung behandelt waren, befand sich eine diplo-tetraploide Chimäre. Obschon die Fruchtbarkeit bei 2x mehr als 89% beträgt, ist sie bei 1x und 1x×2x 0, bei 4x or 4x×2x 25% oder etwas mehr.

339. Chromosomenstudien an Orchidazeen. III. Über das Vorkommen von haploiden Pflanzen bei *Bletil'a striata* REICHB. f. var. *gebina* REICHB. f. Tadamasa MIDUNO. (Cyt. **11**, 1940, 156-177, 86 Textfig.).

Die Kreuzung *Bletilla striata* var. *gebina* (2n=32)×*Eleocharis japonica* (2n=40) hat zwei Sorten Nachkommen gegeben. Die erste davon, welche erst nach 20 Jahren seit dem Säen aufzublühen begonnen haben, sind nach den Resultaten karyologischer Studien als die haploiden Pflanzen (2n=16) erkannt worden. Sie sind offenbar parthenogenetisch entstanden. Die zweite Gruppe Nachkommen, welche 2n=36 enthalten, sind als die Bastarde zu deuten; sie haben noch nicht geblüht.

Die Reduktionsteilung der PMZ bei *Bletilla striata* var. *gebina* geht immer unregelmässig vor. Auch in I- und II-Metaphase wurde die Verbindung einiger Bivalente zu Zweier-, Dreier-, und Vierergruppen beobachtet (sog. Sekundärverbindung). Diese Verbindung ist in der II- Metaphase fest und erscheint als Bi-, Tri-, oder Tetravalente in Kettenform.

Bei der Reduktionsteilung der PMZ bei haploiden Pflanzen hat man fast alle Eigentümlichkeiten wahrgenommen, welche bisher bei den anderen Haploiden aufgefunden worden sind, so z.B. ist der Unterschied zwischen Diakinese und Metaphase undeutlich, die Univalente liegen in der Spindel zerstreut umher, und sie wurden ganz zufällig verteilt.

Wegen der unregelmässigen Reduktionsteilung werden die Pollenkörner verschiedener Chromosomenzahlen ausgebildet.

Für weitere Einzelheiten sei auf das Original verwiesen.

340. Chromosomenstudien an Orchidazeen. IV. Chromosomenzahlen einiger Arten und Bastarde bei Orchideen. Tadamasa MIDUNO. (Cyt. **11**, 1940, 180-185, 27 Textfig.).

Betreffend 21 Orchidazeen, und zwar darunter 3 Bastarde hat der Verf. die 2n- und in drei Fällen die n–Zahl untersucht. Die Resultate sind in einer Tabelle gezeigt und zugleich illustriert. Die 2n–Zahl ist verschieden und beträgt 30, 36, 38, 40, 42 und 48. Die Vergleichung seiner Angaben mit denselben anderer Forscher wird gemacht.

341. *Nanocnide* of China. (Japanese and Latin). Hisao MIGO. (J. Jap. B. **16**, 1940, 1 text-fig.).

Nanocnide japonica BLUME and *N. pilosa* MIGO are enumerated; the literature and distribution are given.

342. Contributions to the study of genus *Saccharum* I. Observations on the F_1 progeny of sugar cane—*Sorghum* hybrids. Akira MORIYA. (Cyt. **11**, 1940, 117-135, 38 text-figs.).

A variety of cane sugar called 2725 POJ (2n=107)♀×*Sorghum vulgare* (n=10)♂ was done. In the former, besides the bivalents the uni- and occasionally the multivalents were observed in the meiosis of PMCs.

According to their external appearance the F_1 offspring were classified into three

types, normal-like sugar cane, dwarf, and intermediate between the above two. In the first 2n=118, which was probably derived from the doubling of the maternal chromosomes, so that if the haploid set of chromosomes of sugar cane and that of *Sorghum* are represented by C and S respectively, the chromosome set of that type should be 2C+1S.

In dwarf and intermediate type 2n=64 which will correspond probably to 1C+1S.

In the meiosis of PMCs in normal-typed plants about 10 univalents are derived probably from *Sorghum*. In the intermediate type usually 37 chromosomes consisting of uni-, bi-, and sometimes multivalents were seen. The number of the univalents was greater than 10. and according to the author's hypothesis this may be due to the fact that many chromosomes of haploid set of sugar cane united autosyndetically to form bi- and multivalents, and the *Sorghum* chromosomes remained as univalents.

343. Chromosome number of the wild sugar cane (*Saccharum spontaneum* L.) in Taiwan. (Preliminary note). Akira MORIYA. (Reprint from Proc. of Soc. Sugar Cane Investigation in Taiwan **18**, 1940, 291-293, 3 text-figs.).

The wild sugar cane in Japan may be classified into *Saccharum spontaneum* L. subsp. *indicum* HACKEL var. *genuina* HACKEL (culm lower than ±2m, slender leaves) and *S. spontaneum* L. subsp. *indicum* HACKEL var. *Roxburghii* HONDA (easily distinguishable from the former by the height of culm and general appearance). The karyological study has shown that in the former n=56 and 2n=113 and the meiosis of PMCs is regular. In the second variety n=48, 2n=96, and the meiosis of PMCs is also regular.

A form of *S. spontaneum* from the Amami Island shows 2n=104, which lies just intermediate between the two 2n-numbers above cited. Since it does not yet flower, no n-number is yet known.

344. Cyto-ecological studies on rice, *Oryza sativa* L. (Japanese). Tutumi NAGAMATU. (J. J. G. **16**, 1940, 278-281).

By artificially changing external conditions in various ways (short day treatment, either cooling or warming at night) the author has studied the effect of such treatment on the time of heading and the degree of fertility. In this respect he has turned his attention, especially to the genome number (di-, tri-, tetra-, or haploid), and the ecological type of individuals (northern, southern and median types). He could see frequently that the effect of such treatment is somewhat different according to the genome number of individuals, but in certain cases (for instance, in that of median type) he could hardly observe the dependency of the effect on the genome number. On the contrary, he could clearly observe the considerable difference of the effect in different types quite independently from the genome number (for instance, acceleration of heading in median type, and its delay in southern type). The conclusion of the author was that the effect of the above treatment does not depend upon the genome number, but rather on the nature of the genes contained in the genome.

Fertility was highest under natural condition and lowered down by any artificial treatment (short day, cooling or warming at night). It was observed that when the above treatment was practised, the fertility was higher in tetraploids than in others.

345. Genetisch-physiologische Studien über die Gattung *Linum* II. Verwandtschatliche Beziehung einiger kultivierten Leinarten auf Grund ihrer Chromosomenzahl. (Japanisch). Masato NAGAO. (A. H. **15**, 1940, 841-844, 9 Textabb.).

Auf Grund sowohl seiner eigenen als anderer Untersuchungen hat der Verf. 5 verschiedene Leingruppe unterschieden:

1.Gruppe. n= 8, einjährig, z.B. *Linum grandiflora.*

2.Gruppe. n=15, 2n=30, bisweilen n=16, 2n=32, einjährig, ausgenommen vieljähriges *Linum angustifolium*, z.B. *L. usitatissimum*, *L. crepitans*, *L. angustifolium.*

3.Gruppe. n=14, vieljährig, z. B. *L. campanulatum*, *L. flavum.*

4.Gruppe. n= 9, vieljährig, z. B. *L. maritimum*, *L. hirsutum.*

5.Gruppe. n= 9, vieljährig, z. B. *L. tenuifolium*, *L. Lewisii*, *L. montanum*, *L. Narbonense* usw.

Die Kreuzung zwischen den zu verschiedenen Gruppen gehörenden Arten war bisher immer erfolglos.

346. Association of chromosomes in *Chelidonium*. (Japanese with English résumé). Masato NAGAO and Kan'iti SAKAI. (J.J.G. **15**, 1940, 23-28. 25 text-figs.).

The somatic number of chromosomes in *Chelidonium majus*, as examined in its root-tip cells, is 10, which is different from what SUGIURA has formerly announced, namely n=6. The chromosome is either V- or J-shaped according to the insertion point in the spindle fibre.

In PMC all univalent chromosomes are connected end to end to form a closed ring. In another case two rings, each formed from 4 chromosomes+one formed from 2, in still another case one from 6+one from 4 are observed, etc.

There is always a close connection between the nucleolus and certain chromosomes, and the authors think that there should exist a certain number of satellites or nucleolar chromosomes.

The linked chromosomes are so arranged in the equatorial plate that in side view they are in zigzag. In anaphase contiguous chromosomes wander to the opposite poles and the alternate ones to the same, though there may be sometimes abnormal distribution of chromosomes. Laggards are sometimes seen, and consequently many pollen grains are abortive.

347. Iconographia plantarum Asiae-Orientalis Vol. III, No. 4. Edited by Takenoshin NAKAI. Tôkyô, 1940, 11 pls. and 33 pp.

The following plants are contained in this No., which completes Vol. III: *Arisaema proliferum* NAKAI (2 pls.), *A. speirophyllum* NAKAI, *A. solenochlamys* NAKAI (above three by NAKAI), *Cremastra variabilis* NAKAI (by Y. KIMURA), *Euphorbia Nakaii* HURUSAWA (by I. HURUSAWA), *Cornopteris hakonensis* (2 pls.), *Dryopteris fuscipes* C. CHRISTENSEN var. *typica* H. ITÔ (above two by H. ITÔ), *Leptocolea miyajimensis* HORIKAWA var. *microdentata* HATTORI (by S. HATTORI), *Nitella fallosa* MORIOKA (by H. MORIOKA).

348. A new classification ot the Sinico-Japanese genera and species which belong to the tribe Camellieae (I)-(II). (Japanese with Latin diagnoses). Takenoshin NAKAI. (J. Jap. B. **16**, 1940, 659-667, 691-704, 4 text-figs.-groups).

In contrast to several preceding taxonomists the author thinks that the genera *Camellia* and *Thea* should rightly not be united into one genus. Basing on this view he has enumerated 33 species of *Camellia* (incl. *C. hiemalis* NAKAI, sp. nov., *C. obscura* NAKAI sp. nov., 6 species of *Camelliastrum* NAKAI, gen. nov., 6 species of *Thea* KAEMPFER, 14 species of *Theopsis* NAKAI, gen. nov. and 6 species of *Tutcheria* DUNN.

349. Über die Keimung und Entwicklung von für lange Zeit aufbewahrten Samen. (Japanisch). Yôzô NAKAJIMA. (A. H. **15**, 1940, 1451-1458, 6 Textfig.).

Die Keimungsfähigkeit der während 18-21 Jahren aufbewahrten Samen einer Anzahl von Pflanzen wurde durch den Verf. untersucht. Die Aufbewahrungsweise

war ganz einfach: frische Samen wurden in einem dichtgeschlossenen Glasgefäss mit etwas trockenem Chlorkalk zusammengestellt. Die Versuchsresultate sind ausführlich in einer Tabelle dargestellt. Danach wurden unter allen vom Verf. untersuchten Samen die Maiskörner am längsten ihre Keimungsfähigkeit behalten zu können erkannt, indem nach der Aufbewahrung während 20 Jahren und 7 Monaten ihre Keimung 100% betrug. Dann folgen ihnen die Samen von folgenden Pflanzen in dieser Hinsicht nach, nämlich, *Celosia cristata* var. *linearifolia, Vicia hirsuta, Eleusine coracana.* Bei den folgenden, obschon die Keimungsfähigkeit etwas niedriger als bei den vorigen ist, doch ist sie ziemlich gross, *Setaria viridis, Veronica arvensis, Ambrosia artimisifolia, Pharbitis Nil.* Das Vermögen des Behaltens der Keimfähigkeit ist schwächer bei Weizenkörnern als bei Gerstenkörnern, und bei nackten Gerstenkörnern als bei den beschalten. Die Keimungsfähigkeit der Reiskörner wurde nach langer Aufbewahrung stark geschwächt, und erst wenige können zur Keimung kommen (±10%), wenn sie von ihren Spelzen befreit werden, welche nach der Verfs. Ansicht wahrscheinlich das Eindringen des Sauerstoffes im Sameninnern verhindern sollen. In solchen Fällen geht die Keimung nicht selten in anomaler Weise vor sich, z.B. verkümmerte Entwicklung von Keimknospen und -wurzeln, die Entwicklung der Adventivwurzeln statt der Keimwurzel, die Störung des Geotropismus des jungen Stämmchens usw. Solche anomale Keimlinge gehen oft bald zu Grunde, doch wenn sie sorgfältig kultiviert werden, können sie normal entwickeln, ohne nachweisbaren Unterschieden aus den typischen Pflanzen.

Die folgenden Pflanzen haben vollständig ihre Keimungsvermögen verloren nach langer Aufbewahrung: Weizen, verschiedene Sippen von *Hordeum sativum nudum, Serilla japonica, Impatiens Balsamina, Mirabilis Jalappa, Sisyrinchium angustifolium.*

350. On the utility of the stored *Lilium* pollen and abnormal seed n crosses of *Lilium speciosum, L. auratum, L. speciosum, L. Makinoi.* (Japanese with English résumé). Yôzô NAKAJIMA. (B. M. T. **54**, 1940, 473-483, 5 text-figs.).—**Hybrids of *Lilium speciosum* and *L. auratum* with supplementary notes on the preservation of pollen and the culture method of abnormal seeds.** (Japanese). By the same author. (Practical Horticulture **26**, 1940, 13-17, 1 colour-plate and 3 text-figs.).

By preserving the pollen of several species of *Lilium* the author has performed various crosses between those of different flower seasons. Pollen was preserved under cool and dry condition, and in order to avoid excessive dryness, he has used glycerine as dessicating agent, which he had used formerly in the storage of *Salix* pollen with success. Pollen may be preserved in this way even as long as one year, without losing its effectiveness, though it diminishes gradually.

Among various crosses executed by the author the most interesting one is that *Lilium speciosum*×*L. auratum* which corresponds to the "*crimson auratum*" made by PARKMAN after long years' labour (shown in Gardener's Chronicle 1875) as well as that *L. auratum*×*L. speciosum* which corresponds to the cross made by HAYWARD (1914).

The capsules resulting after the crossing are somewhat larger than those of each parent. But almost all seeds contained therein are abnormal with soft milky endosperm and unable to germinate. The author has however succeeded in the elevation of mature plants from such seeds as follows. Embryos were artificially taken out from such seed, which is quite easily done on account of soft endosperm instead of hard one as in the parent. They were at first cultured in a certain nutrient medium (2–5% glucose, 5–10% cane sugar, or 5% fructose, to which little mannite or mannose is added), and in the stage when the primary roots appear the whole is transferred to

the sand culture in pot with the KNOP's solution, and finally the pot culture in ordinary way is done. Such plants have developed so far as to bear flowers. The beautiful flower of *L. speciosum*×*L. auratum* is shown in a colour-plate of the second paper cited above.

351. Über die Bedeutung der Hydrogenation bei Bioluminescenz. (Japanisch m. deutsch. Zfg.). Hirosi NAKAMURA. (B. M. T. **54**, 1940, 314-318).

Die aus der Leuchtkrebse *Cypridina hilgendorfii* extrahierten Luciferin und Luciferase wurden gemischt, um nach einiger Zeit Luciferin ganz zu Oxyluciferin umzuwandeln. Zur in dieser Weise hergestellten Oxyluciferinlösung wurde die Suspension von *Bacterium coli commune*, *B. coli formicum*, oder *Rhodobacillus palustris* hinzugefügt, alle von welchen die Hydrogenase zu produzieren bekannt sind. Das ganze wurde in H_2-Atmosphäre einen Tag stehen gelassen. Durch den Luciferase-Zusatz und O_2-Zufuhr wurde das Leuchtvermögen wiederhergestellt. Dieser Versuch wird zeigen, dass Oxyluciferin durch Hydrogenase zu Luciferin wieder reduziert werden kann.

Nach JOHNSON, VAN SCHOUWENBURG und VAN DER BURG leuchtet sich *Photobacterium Fischeri* in Anaerobiose (H_2-Atmosphäre) beim Zusatz von Fumarat stärker als beim Fehlen desselben. Nach den obenzitierten Autoren soll diese Erscheinung lediglich auf die Anaerobiose zurückgeführt werden. Nach NAKAMURA muss es etwas anders sein. In seinem gleichartigen Versuche konnte er in einer N_2-Atmosphäre kein Anleuchten, aber in H_2-Atmosphäre deutliches Leuchten beobachten, woraus er schliesst, dass diese Erscheinung auf die Wirkung der Hydrogenase zurückgeführt werden muss.

Somit kann man im allgemeinen sagen, dass die Bioluminescenz mit der Hydrogenase-Wirkung in enger Beziehung stehen wird.

352. Über die quantitativen Beziehungen zwischen der Katalase im Chloroplasten und dem Chlorophyll, nebst einigen Bemerkungen über die Rolle der Katalase im Assimilationsvorgang. Hirosi NAKAMURA. (Jap. J. B. **11**, 1940, 221-236, 16 Tabellen).

353. One instance of tomato ring mosaic (?) on tobacco. (Japanese). Kakugorô NAKATA and Seitô TAKIMOTO. (A. H. **16**, 1940, 401-410, 1 color-plate and 10 text-figs.).

Some years ago the authors have found on tobacco the virus disease which produces on its leaves the bright yellowish mottling. It causes considerable damage on tobacco and tomato, and often leads to death, especially in the latter. Inoculation experiments have shown that it may infect a great number of solanaccous plants. Its resistance against dryness and various chemicals is intense.

It resembles very much the tomato ring mosaic observed by E. M. JOHNSON on tobacco in Kentucky, U.S.A.

354. A ring strain of tobacco common mosaic found on the pepper. (Japanese with English résumé). Kakugorô NAKATA and Seitô TAKIMOTO. (B. S, F. T., K. I. U. **9**, 1940, 179-189, 13 text-figs.).

A virus disease of pepper, ring mosaic, infects pepper (*Capsicum annuum*), producing bright yellowish mottling or ring on leaves of some strains and locally restricted spots on those of others. A great number of solanaceous plants are susceptible to this disease.

The virus under discussion retains its infective power even at 1:100,000 dilution and becomes ineffective when exposed to 90°C for 10 min. This virus disease should be according to the authors a strain of tobacco mosaic virus, *Nicotiana* virus 1 (MAYER) ALLARD.

355. Studies on the "yellow tobacco mosaic" or "aucuba mosaic" of tomato. (Japanese with English résumé). Kakugorô NAKATA and Seitô TAKIMOTO. (B. S., F.T., K. I. U. **9**, 1940, 167–178, 1 color-pl., 10 text-figs.).

The symptoms of yellow tobacco mosaic are identical to those of tomato aucuba mosaic, and its properties coincide generally with those of *Nicotiana* virus C. In *Datura stramonium*, *Nicotiana glutinosa* and *N. sanderae* primary local lesions are produced on inoculated leaves, while in many other Solanaceae yellow mottlings are produced on new leaves.

The virus under discussion is very resistant against high temperature and various chemicals, and its infectivity will remain for one year when kept in a test-tube.

356. A white strain of tobacco common mosaic. (Japanese with English résumé). Kakugorô NAKATA and Seitô TAKIMOTO. (A. PP. S. J. **6**, 1940, 243-254, 1 pl. and 14 text-figs.).

The white mosaic of tobacco which differs from JOHNSON's "white mosaic" was found in Hukuoka. It is able to infect many Solanaceae, but not *Cucurbita*. In general its virulence is not very destructive, thus, for instance, petunias are simply retarded in their growth. Inoculation on *Nicotiana sylvatica* will produce the mottlings on its leaves. This virus may be a strain of tobacco common mosaic virus (*Nicotiana* virus 1).

357. Comparative studies on the panicle development in normal and dwarf types of rice plant. (Japanese with English résumé). Kane NAKAYAMA. (J. J. G. **16**, 1940, 139-148, 10 text-figs.).

This paper describes the results of comparison of the development of the panicle flower in normal type (AABB) and three dwarf types (AAbb, aaBB, aabb) (cf. this JOURNAL **9**, (126), No 427).

Until ±37 days after sowing there is practically no size difference in all four types above indicated, but 44 days after it the two large types AABB and AAbb begin to develop actively and to differentiate the branches of the first order, while aaBB and aabb remain yet unchanged. The branches of the second order begin to be differentiated in all after about 50 days. In these branches the primordia of lemma and palea are formed in AABB and AAbb, but not in others. In the lapse of 10 days thereafter all floral organs are fully developed. In the last stage, though the panicle length in aaBB and aabb is considerably shorter than in AABB and AAbb, it is remarkable that the size of flowers which are well developed is nearly the same in all types.

It will be remarked that the greater length of panicle in large types is caused by more active cell-divisions and the more advanced development of cells than in dwarf types, and not at all by larger dimension of cells.

358. A study on the infection of cotton seedlings by *Rhizoctonia solani*. (With Japanese résumé). Takao NAKAYAMA. (A. PP. S. J. **10**, 1940, 93-103, 3 text-figs.).

The cotton seedlings were inoculated with *Rhizoctonia solani*. It was observed that the hypha progresses along the slightly depressed seam of the epidermis in the root, hypocotyl and cotyledon, the depression becoming gradually deeper. Infection in the root takes place through the naturally injured parts of the tap-root, wherefrom lateral roots will issue out. Infection in the hypocotyl occurred chiefly by means of masses of mycelia or so-called infection cushion. The infection of cotyledons takes place through the cuticle as well as stomatal openings.

359. Effects of fast neutrons upon plants IV. Cytoplasmic changes in *Spirogyra*. Y. NISHINA, Y. SINOTÔ and D. SATÔ. (Cyt. **11**, 1940, 311-318, 5 text-figs.).

The "cytoplasmic elasticity" (NORTHEN) is measured usually by centrifuging, and it was practised by the authors after the exposure to the action of fast neutrons. The materials were *Spirogyra*, generally with many chloroplast-bands. The materials which were at first placed in the dark, were exposed to the bombardment of fast neutrons, replaced in the dark for certain hours, and then examined. The change of elasticity was measured by the quantity of displacement of chloroplast-bands, and this will chiefly due to the alteration in the condition of the peripheral cytoplasm, especially of "Rinnenplasm" (SAKAMURA) which connects the chloroplast-bands to the cell-membrane The observation has shown that the exposure to the action of fast neutrons decreases the cytoplasmic elasticity. especially in the case of strong treatment.

The authors have tried in their experiments to replace the centrifuging method by the plasmolytic one, but no decisive results were obtained.

360. On two *Alternaria* species injurious to cotton fibres in balls. (Japanese with English résumé). Y. NISIKADO, K. KIMURA and Y. MIYAWAKI. (A. PP. S. J. **10**, 1940, 214-230, 7 text-figs. and 2 graphs).

Two species of *Alternaria* injurious to cotton fibres in nearly ripened balls were recently found in Japan, viz. probably *Alternaria macrospora* ZIMMERMANN and *A. Gossipii* (JACZ.). The former attacks the cotton leaves, balls and fibres in balls, and the latter chiefly the fibres. Inoculation experiments have caused the discolouration or blackening of cotton fibres in all cases, except in that of absorbent cotton.

Temperature relation: minimum, optimum and maximum for the mycelial growth in both fungi 5°, 27–30° and 36° respectively. pH: acid limit for the mycelial growth ±2, alkali limit ±10, optimum ±5.

361. Physiological studies on laminarin and mannitol of brown algae II. The seasonal variation of their content in *Eisenia bycyclis*. Kazutosi NISIZAWA. (Sc. Rpts., T. B. R. D. **5**, 1940, 9-14, 2 graphs and 1 table).—**III. Variation of their content in *Eisenia bicyclis* through various stages of growth.** By the same author. (Ibid., 15–19, 2 graphs and 1 table).

According to the results of investigation of several authors (KYLIN, RICARD, etc.) the laminarin accumulates in the plant body in summer and is consumed in winter, and no relation between laminarin and mannitol is recognizable.

The author's study concerning *Eisenia bicyclis* has confirmed the above view on laminarin, because it is most abundant in August, and gradually decreases towards the winter, when it is almost wholly absent. The seasonal variation of mannitol is just the reverse of laminarin, because the maximum stage of laminarin in August corresponds to the minimum stage of mannitol and vice versa, so that the author thinks that there might be some physiological connection between the two.

In *Eisenia bicyclis* both laminarin and mannitol are in minimum in young stage, probably because they are then used up for their active growth; both increase parallel to the growth of the alga.

362. On the cytological studies in *Reineckia carnea* KUNTH III. Macrosporogenesis and development of the embryo-sac. (Japanese with English résumé). Tsuta NOGUCHI. (B. M. T. **54**, 1940, 483-493, 36 text-figs.).

Macrosporogenesis of normal type was observed in *Reineckia carnea*. In I-metaphase of the embryo-sac mother-cell 19 bivalents are seen, and of four tetrads produced after the meiosis of the macrosporophyte only one survives to develop into the embryo-sac. As the consequence of three successive divisions of the nucleus of the latter 8-nucleate embryo-sac comes into existence.

363. Investigations on the photosynthesis of leaves in rice plants. Yakiti NOGUTI. (Jap. J. B. **11**, 1940, 167–191, 7 text-figs. and 16 tables).

364. On the injury of rice-seedlings caused by sulfate-reducing bacteria in common paddy field. (Japanese with English résumé). Hisayosi NOSE. (A. PP. S. J. **10**, 1940, 193-202).

Formerly the author has published his observations on the damage done by sulfate-reducing bacteria on the rice-seedlings in tidal paddy field in Corea. Later, similar injurious effects have been observed by the author in common paddy field.

The sulfate-reducing bacteria were *Microspira desulfuricans* (BEIJERINK) VAN DELDEN as well as *Pseudomonas* sp., etc. The field is distinguished by containing much organic matter and stagnant water; the reaction of soil is weakly alkaline, pH being 7.1–7.3. The symptom of injury begins to appear on the seedlings, whose cotyledons measure 1–3 cm; the latter are weak, curved and are almost chlorophyll-free. Proper leaves, without expanding, go to rot and die. Roots which are prevented from growing up die and blacken.

No pathogenic fungi were found.

365. Supplement to the census of Hainan plants. (With Japanese résumé). Kijiro ODASHIMA and Tyôzaburô TANAKA. (J. S. T. A. **12**, 1940, 193–204).

New additions, corrections, etc. of the census of Hainan plants formerly published (cf. this JOURNAL **10**, (23), No. 92).

366. Preliminary report on the leaf spot disease of *Camellia japonica* caused by *Graphiotheciam Kusanoi* sp. nov. (Japanese with English résumé). Takasi OGAWA. (A. PP. S. J. **10**, 1940, 269–277, 7 text-figs.).

Graphiothecium Kusanoi sp. nov. produces on leaves of *Camellia japonica* greenish white spots which are black in the centre, so-called "snake-eyed spots." The infection takes place through the stomata on the under surface of leaves. The stroma is formed in the respiratory cavity. Later the fungus breaks up through the overlying layers, and exposes a conical protuberance externally. Conidia are finally produced.

367. New examples of aerial roots in tropical swamp plants. (With Japanese résumé). Yudzuru OGURA. (B. M. T. **54**, 1940, 327-337, 1 pl. and 7 text-figs.).

Urandra ammui KANEHIRA (an Icacinacee from Micronesia) growing in swamps or streams is characterized by producing the roots growing upwards, and living above ground. These aerial roots are similar externally to the so-called respiratory roots of some mangrove plants, such as *Avicennia*, *Sonneratia*, etc. They differ, however, from the latter, inasmuch as in *Urandra* the structure of aerial and subterranean roots is quite similar, while, as it is well known, in *Avicennia*, *Sonneratia*, etc. both kinds of roots are very different in their structure. *Glochidion hongkongense*, an Euphorbiacee, growing also in swamps or streams in Formosa behaves quite similarly as *Urandra*, though on a much smaller scale. Aerial roots in *Urandra* and *Glochidion* are named "standing roots" by the author.

Horsfieldia amklaal KANEHIRA, a Myrtacee growing in swamp forest in Micronesia, is characterized by producing the roots which grow upwards above ground at first and then curve downwards The growth just pointed out takes place often on a very large scale. "In one place, where a stream about 3 m wide is running, the root system is very prominently developed, reaching mostly more than 1 m in height; moreover, a thick root curves over the stream and reaches the opposite side....just like a

bridge about 5 m long." These aerial roots resemble somewhat the well known knee-root, but differ from the latter by being simpler in shape without showing any abnormal thickening. The author calls them "curving roots."

The anatomical structure of the above three species is described. In the first two the cortex is wide and the central cylinder relatively small, while in the third just the reverse takes place.

368. On the types of abnormal roots in mangrove and swamp plants. (Japanese with English résumé). Yudzuru OGURA. (B. M. T. **54**, 1940, 389-404, 1 pl. and 14 text-figs.).

Basing on his own observations as well as the literature study, the author proposes to classify the negatively geotropic aerial roots which are generally called respiratory roots.

(1) Curving root (cf. No. 367).

(2) Curved knee-root. In (1) above cited the dorsal part of the curved portion does not differ in its structure from the ordinary underground root, but in (2) the curved part is abnormally thickened, forming a "knee." Examples: *Bruguiera, Ceriops.*

(3) Erect knee-root. The dorsal part of the root undergoes an abnormal thickness growth before protruding above ground, so as to form an erect root above ground. The well known example is seen in *Taxodium, Glyptostrobus, Camptostemon.*

(4) Brewt root. The abnormal growth takes place along its dorsal side throughout the root, so as to form a flat root. Examples: *Xylocarpus, Carapa.*

(5) Standing root. Cf. No. 367.

(6) Erect root. Externally similar to (5), but the structure of the two is quite different. Examples: *Sonneratia, Avicennia, Laguncularia.*

(7) Floating root. Similar to (6), but its wide cortex contains the aerenchyma, so that it swims on the water. Examples: *Jussieua, Ludwigia.*

369. The embryo-sac of *Erythronium japonicam.* (Japanese with English résumé). Kôhei OIKAWA. (B. M. T. **54**, 1940, 366-369, 2 text-figs.-groups).

Formerly it was believed that in *Lilium, Tulipa* and *Fritillaria* the development of the embryo-sac follows the so-called *Lilium* type, where the eight-celled embryo-sac is produced from the embryo-sac mother-cell. Later studies von BAMBACIONI have. however, in contrast to the above observation, proven that the development of the embryo-sac in several Liliaceae, such as *Erythronium persica*, takes place in normal way.

Recently, however, the American botanist COOPER has published his investigation on *Erythronium albidum*, in which the development of the embryo-sac will follow the *Lilium* type.

The author, in studying the development of the embryo-sac in *Erythronium japonicum*, could observe, contrary to COOPER, that its mode is quite normal and perfectly similar to that of *Fritillaria persica.*

The chromosome number in *Erythronium japonicum* is n=12, 2n=24.

370. Growth-promoting and growth-inhibiting substances in the petiole. (Japanese with English résumé). Yasuyuki OKABE. (B. M. T. **54**, 1940, 357 365, 1 text-fig. and 7 tables.

The following experiments were performed in *Morus alba, M. bombycis, Cudrania triloba, Ficus carica, Thea sinensis, Salix viminalis* and *Ginkgo biloba*, and exactly similar results were obtained in all cases.

The experiment consists in putting the end of the petiole into the agar block in order to let the growth-promoting and growth-inhibiting substances contained in it, if any, diffuse out into the latter. The presence of such substances was then tested by the well-known *Avena* method.

It was proven that the petiole contains both these substances: that of young leaves contains the growth-promoting substance and the experiment above indicated leads to the negative curvature of the *Avena* coleoptile, while that of mature leaves contain the growth-inhibiting substance, leading to the positive curvature. It was further proven that the curvature reaction of the growth-promoting substance reaches its maximum two hours after the application of the petiole to the agar block, and that of the growth-inhibiting one hour later.

The growth-promoting substance was observed to move basipetally only, while the growth-inhibiting substance is able to wander both up- and downwards.

One other difference in the behaviour of the two substances is that while the growth-promoting one of the petiole gradually decreases after the removal of leaf-blade, the other one increases gradually after this operation till the fall of the petiole.

371. On the distribution of growth-promoting and growth-inhibiting substances in *Morus alba* L. and *Cassia occidentalis* L. (Japanese with English résumé). Yasuyuki OKABE. (B. M. T. **54**, 1940, 453-461).

Studies were made concerning *Morus alba* and *Cassia occidentalis* to know the distribution of the growth-promoting and growth-inhibiting substances which are diffused out from the stem and root. The experiment consists in placing a piece of the branch (1 cm long or less) in contact with the agar block, either by its upper or lower end. Examination was done by usual *Avena* method. The results were announced below.

In the case, when the branch piece is in contact with the agar block by its lower end, it was observed that its upper, i.e. young part which is just concerned in active growth, diffuses out the growth-promoting substance and will consequently induce the negative curvature of the *Avena* coleoptile. In old part the tendency towards the positive curvature is much more prominent than in young one and that tendency is in maximum near the boundary between the stem and root. Also in the latter the tendency towards the positive curvature is conspicuous in its middle part.

In the case, when the branch piece is in contact with the agar block by its upper end, the positive curvature is observed, showing that the growth-inhibiting substance, by travelling upwards in the stem, diffuses out in the agar block, while the growth-promoting substance does not, inasmuch as, as was noticed in No. 370, the former can move both basi- and acropetally in the stem, while the latter is able to move basipetally exclusively. If, however, the contact with the agar block will be made both with the upper and lower end of the branch, both kinds of substances will diffuse out, and yet the negative curvature occurs, especially in young branches, showing that then the action of the growth-promoting substance prevails over that of the growth-inhibiting one and masks the presence of the latter.

372. On the chromosome number in the genus *Carex*. (Japanese with English résumé). Shun OKUNO. (J. J. G. **16**, 1940, 164-170, 45 text-figs.).

The author has counted the somatic chromosome number in about 40 species of *Carex*. The results are shown in a table, and the chromosomes of each species are illustrated.

The chromosome number in *Carex* is extremely various in different species, 2n

lying between 30 and 90. The polyploid relation was recognized in two cases: in *Carex multifida* there are plants containing 2n=30 and 60, and in *C. stenanthi* those containing 2n=38 and 42. Aneuploidy was found in *C. conica*, 2n=34, 38 and 42. The secondary association of two or three bivalents was observed in *C. pilosa* containing n=32 and 57 respectively, such pairing having never been hitherto recognized in any species.

373. Diploid F_1 hybrids produced from the cross between tetraploid and diploid race in *Oryza sativa* L. (Preliminary note). (Japanese with English résumé). Eiji OKURA. (J. J. G. **16**, 1940, 228-233, 3 text-figs.).

A cross was made concerning the rice plant between a tetraploid ♀ (2n=48) and a diploid ♂ (2n=24), each of which is known to have bred true in successive generations. Except some few which were perfectly identical to the female parent and which were evidently produced on account of selfing due to the failure in pollination, all others were diploids (2n=24), combining the characteristics of both parents. So, for instance, these hybrids resemble the pollen-parent on one hand by their high fertility (74.2% versus the fertility of the mother-plant 33.6%) and the mother plant on the other by their morphological characters (e.g. densely haired and broadly shouldered glumes). The reason why this crossing has given the diploids is not yet clear, though some attempt to explain the fact is done by the author.

374. The effects of the polyploidy upon morphological and physiological characters in *Pisum sativum*. (Japanese). Tomowo ONO. (B.Z. **8**, 1940, 1265–1274, 5 text-figs.).

Comparison was made between the diploid (2n=24) and the tetraploid plant (2n=28) of *Pisum sativum* got by the acenaphthene treatment.

Almost all organs of the tetraploid are larger than those of the diploid, while the number of stomata, pollen grains with full content, seeds in one pod, the length of the latter and the fertility have diminished in the tetraploid in comparison to the diploid.

The polyploids are stouter, their flowering period is longer, their pods are larger than in the normals. Parthenocarpy is often seen.

In the meiosis of PMCs, besides the tetravalents, 2-4 bivalents are met with. In anaphase the chromosomes are generally equally distributed to both poles, but the laggards are seen not rarely, which give rise to miniature nuclei, and consequently besides normal tetrads polyads consisting of 6–8 cells are produced.

Three generations of the hybrid offspring were studied, and the author has observed in a few individuals the variation of the chromosome number, viz. 2n=28, 2n=29 and 2n=30.

375. Colchicine-induced polyploids of *Pisum sativum*. (Japanese with English résumé). Tomowo ONO. (B. Z. **8**, 1940, 1627–1631, 3 text-figs.).

Formerly the author has got the polyploids of *Pisum sativum* by the acenaphthene treatment (cf. No. 374). In the present paper he enunciated the tetraploid pea plant obtained by the colchicine treatment, which consists in immersing seeds in 0.025–0.05% colchicine solution for 1–3 days. Though the results were generally negative, he has got nevertheless the polyploids in three varieties. Induced polyploids which are somewhat different in their characters as compared to normal plants, are especially distinguished by their growth retardation, reduced fertility and large pollen grains. In one of the three varieties above mentioned the chromosomes of the second generation were found to be either 2n=28 (tetraploid) or 2n=29 (hypertetraploid).

376. Polyploidy and sex determination in *Melandrium*. III. Intersexes in *M. album*. (Japanese with English résumé). Tomowo ONO. (B. M. T. **54**, 1940, 348-356, 2 text-figs. and 6 tables).

The combinations, tetraploid (4x × 4x) as well as triploid (4x × 2x) have given rise besides normal male and female individuals a certain number of intersexes. Some of the latter bear hermaphrodite flowers in the true sense of the word, but in some others either the stamens or the pistils are well developed, while in still some others either the pistils or the stamens are quite imperfect. (i.e. euhermaphrodite, male or female intersexes respectively). Generally, however, polyploid intersexes have the same constitution as that of the male type, so that the intersexes should be considered as modified males.

377. Die Geschlechtstypen und ihre Vererbungsverhältnisse bei *Rumex hastatus*. (Japanisch m. deutsch. Zfg.). Tomowo ONO. (J. J. G. **16**, 1940, 234-245, 5 Textfigg. u. 8 Tabellen).

In *Rumex hastatus* gibt es sowohl reinweibliche als zwitterige Individuen. Die Blüten der ersteren, welche ganz normal sind, sind völlig fruchtbar durch die Bestäubung mit Pollen des Zwitters. Bei den Blüten der letzteren, dagegen, obgleich die Antheren normal ausgebildet sind, sind die Karpelle etwas kümmerlich entwickelt; sie sind ganz oder fast ganz steril durch die Freibestäubung. Die 2n-Zahl ist 18, und bei der Meiose der PMZ 9 Bivalente wurden beobachtet.

Die Kreuzung, Weibchen × Zwitter gibt die Nachkommenschaft, welche aus der ungefähr gleichen Zahl von Weibchen und Zwitter besteht, sodass wir hier mit der Kreuzung der homo- und heterozygotischen Gameten zu tun haben. Weiter hat der Verf. die Selbstbestäubung des Zwitters ausgeführt, wobei nicht nur die Zwitter, sondern auch die Weibchen entstanden sind, sodass man auf die heterogametische Natur des Zwitters schliessen kann.

378. Chromosome studies in *Oryza sativa* L. II. An unexpected asynapsis of the pollen mother-cell chromosomes. (Japanese with English résumé). Kan'iti SAKAI. (J. J. G. **16**, 1940, 193-202, 33 text-figs.).

In the summer of 1934 the author has observed in three strains of rice cultivated in Hokkaido the occurrence of very remarkable asynapsis in the pollen mother cells. Since such phenomenon was not observed in the same strain during four successive years, the cause has hitherto not yet been explained, though this might be due to a certain external influence, such as low temperature, etc. That year (1934) corresponds just to that of very poor harvest of rice in Hokkaido as well as Northern Honsyû.

The asypnatic phenomenon is as follows:

In diakinesis, prometaphase I and metaphase I many PMCs were distinguished by containing a certain number of univalents besides normal bivalents, so, for example, the cells with two univalents (either on the same or one by one on the opposite sides of the nuclear plate), were most frequently met with, and those with 4, 6, 8, 10, 12, 16, 20 (?) and 24 (i.e. completely asypnaptic) univalents were seen.

Univalents lie rarely within the equatorial plate, but generally are scattered in the spindle region. Such irregularity leads necessarily to the pollen abortion and the consequent low fertility (±20%).

379. On the facilitated infection of the rice blast fungus, *Piricularia oryzae* CAV. due to the wind. I. (Japanese with English résumé). Masayuki SAKAMOTO. (A. PP. S. J. **10**, 1940, 120-126).

It has been frequently observed that the blast disease of rice plant breaks out severely after storming weather.

Experiments were made by the author to expose artificially the host plant to strong wind for several hours and then to inoculate it by the blast disease fungus. In consequence of this procedure a marked increase of infection was observed. This will be due, partly to the mutual rubbing or fluttering of leaves in the strong wind and the consequent production of wounds, and partly to the dryness or mechanical injury.

380. Fragmentary news from the Herbarium of the Tōkyō Science Museum (I). (Japanese with Latin diagnoses). Yosisuke SATAKE. (J. Jap. B. **16**, 1940, 421-426, 3 text-figs.).

The following new plants are announced among others: *Juncus decipiens* NAKAI var. *filiformis* SATAKE, var. nov., *Draba linearis* SATAKE sp. nov., *Gentiana Takedai* KITAGAWA var. *secta* SATAKE, var. nov., *Swertia Kanasiroi* SATAKE sp. nov., *Deutzia ferruginea* SATAKE, sp. nov.

381. A list of Mongolian plants collected by Mr. H. AZUMA in 1937. (Japanese). Yosisuke SATAKE. (J. Jap. B. **16**, 1940, 604-612).

142 species are enumerated. Besides there are 11 species which are not yet identified.

382. A revision of the Japanese *Eriocaulon*. Yosisuke SATAKE. (B. T. S. M. No. **4**, 1940, 70 pp text, 5 pp literature and index, 12 pls., 1 text-fig., 1 map).

A monograph of the Japanese species of *Eriocaulon*. The genus is divided into two subgenera, Astole and Trimeranthus. The first contains 1 section and the second 4. Some sections are subdivided into subsections and series. The total number of species is 36 which are described in detail.

383. East Asiatic lichens (IV). (With Japanese résumé). M. M. SATÔ. (J. Jap. B. **16**, 1940, 495-500).

The following lichens are enumerated: *Haematomma ventosum* (L.) MASSALONGO var. *lapponicum* (RÄS.) LYNGE, *H. puniceum* (SW.) MASSALONGO var. *polycarpa* (ZAHLBR.) SATÔ, comb. nov., *H. Fauriei* ZAHLBR., *H. ochrophaeum* (TUCK.) MASSALONGO, *H. syncarpum* ZAHLBR., *Lecanora rubina* (VILL.) ACHARIUS.

A key for the determination of *Haematomma* species is given.

384. Systematic anatomy of the articulated corallines (II). *Amphiroa misakiensis* YENDO. (Japanese with English résumé). Sôkiti SEGAWA. (J. Jap. B. **16**, 1940, 488-494, 5 text-figs.).

The chief results of the author's studies are as follows:

The layer of meristematic cells at the frond apex is covered by a layer of "Deckzellen," which seems to be occasionally renewed. The medullary strand is made up of one or two rows of long cells alternating with a row of short cells, and since the cortical layer is built up of a row of short cells, the boundary between the medullary and the cortical layer is quite distinct. Between the cells belonging to different series secondary pits are seen, and in the node the pits are clearly visible. All conceptacles, carpogonial, antheridial, sporangial, are immersed in the cortex.

Amphiroa misakiensis seems to correspond to *A. rigida* in various respects.

385. A census of fibre plants in Formosa. (Japanese). Tsunetoshi SHIBUTANI. (J. S. T. A. **12**, 1940, 297-304).

A list of Formosan plants, either cultivated or wild, of which the fibres were used formerly or are used at the present time practically and also, though never yet used, might be used in future with profit. Such plants belong to 52 families and contain 203 species in all. They are mostly the angiosperms, 88 mono- and 109 dicotyledons, of which the Gramineae and the Malvaceae include the largest number of species.

386. Studies on the effect of the centrifugal force upon nuclear division. (K. FUJII et al, On the mechanism of nuclear division and chromosome arrangement VI). Tamaki SHIMAMURA. (Cyt. **10**, 1940, 186-216, 45 text-figs.).

The PMC of *Lilium japonicum* in living state was subjected to the action of the centrifugal force, and the effect was studied on fixed specimens. The speeds of the centrifuge were 3000 and 6000 revolutions per minute at a radius of 13 cm, and the centrifugal force was calculated to be 1037 g and 5226 g respectively.

The chief interest of the present paper lies in confirming the existence of traction fibres in the spindle, which are often considered as mere artifacts and the non-existence of the connecting fibres in the spindle in vivo. It may be remarked that the traction fibres are those attached to a chromosome on one hand and one of the spindle-poles on the other, while the connecting fibres are those believed to stretch between the two divergent groups of daughter chromosomes.

According to the author the existence of the traction fibres in vivo may be inferred chiefly from the two following facts. Firstly, when the centrifugal force acts parallel to the longitudinal axis of the spindle the anaphase groups of chromosomes differ entirely in their reactional behaviour on two opposite sides, inasmuch as on the centripetal side they take the form of a closed umbrella, while on the centrifugal side they look like an open umbrella. This fact is considered by the author to indicate the real existence of the traction fibres. He says, "if all chromosomes were tracted to the pole only by the fibres that are attached to the insertion regions the ends of the two arms of the chromosomes would then be comparatively free to move in any direction. The atractoplasma as a whole being slightly compressed longitudinally to the centrifugal side, the part between the pole and chromosomes is also compressed towards the centrifugal pole, so that the converging apices of the chromosomes are compelled to expand," leading to the wider opening out of the chromosome arms than in ordinary case. "On the centripetal side the polward region of the spindle is stretched, so that the chromosomes approach one another." Secondly, "in the late anaphase, shortly before all the chromosomes reach the pole, the centripetal parts of the individual chromosomes are conspicuosly stretched and narrower in diameter, while the centrifugal parts retain nearly their original form."

The second part of the author's experiments consists firstly in treating the material with chloral hydrate or colchicine and then in centrifuging. Since neither atractoplasma nor spindle-fibres are formed after the treatment with the above reagents, the chromosomes, on centrifuging, are thrown towards the centrifugal side, irrespective of their relative positions, as the poles themselves are not formed.

387. Studien über die Frostwiderstandsfähigkeit der Teepflanzen. (Japanisch m. Zfg. in Esperanto). Takasi SIMURA. (J. C. S. S. J. **12**, 1940, 98-114).

Die Fähigkeit des Kältewiderstandes ist von verschiedenen äusseren Bedingungen abhängig. Im Winter (Nov.-Dez.) ist der Grad des Kältewiderstandes zum Wassergehalt der Individuen umgekehrt proportional; das gleiche Verhältnis gilt auch für den osmotischen Druck der Individuen.

1% Lösung von Kaliumjodid wirkt giftig, indem dadurch die rotbraunen Flecke auf die Blätter produziert werden. Nach den Verfs. Versuchen, je kleiner die Empfänglichkeit der Pflanzen gegen Gift ist, desto grösser der Kältewiderstand derselben sein wird. Weiter, wenn man einen kleinen Zweig der Teepflanze in einer 0.01–0.1% Eosinlösung eintaucht, so sieht man, dass die daran sitzenden Blätter allmählich sich rot färben. Im Winter, je färbbarer dabei die Blätter sind, desto schwächer der Kältewiderstand sein wird.

388. Further studies on the resistance to brown blight in tea plant. (Japanese with English résumé). Takasi SIMURA. (J. J. G. **16**, 1940, 246-256, 8 graphs).

It is quite natural that the degree of resistance against brown blight disease caused by *Guignardia camelliae* (COOKE) BUTLER is extremely variable in different varieties of the tea plant. The chemical analysis of tea leaves has clearly indicated that those of resistant varieties contain in general more tannin and less nitrogen than those of susceptible ones and that the degree of resistance depends upon the ratio nitrogen/tannin, because the greater this ratio, the more resistant the variety. When the juice extracted out from tea leaves by boiling are added to the culture of the causal fungus, the growth of its mycelial growth is quite different, as whether the juice is derived from the leaves of susceptible or resistant varieties: in the former case the mycelial growth is vigorous, whilst in the latter it is considerably inhibited. Again, when tannin is removed from the leaf juice, the degree of resistance is proportional to the quantity of nitrogen contained therein

Further, it was ascertained that coffein prevents the mycelial growth, while, on the contrary, peptone, asparagin, glutaminic acid, glycocoll promote it.

389. Studies on the formation of ascorbic acid 3. Relation between the accumulation of ascorbic acid and the carbohydrate content in plants. Tomota SUGAWARA. (Jap. J. B. **11**, 1940, 147–165, 4 text-figs. and 10 tables).

390. Meiotic chromosomes in *Populus nigra* and *Toisusu cardiphylla*. (Japanese). Tiharu SUTO. (J. J. G. **16**, 1940, 304-306, 11 text-figs.).

In the salicaceous plants studied by the author, viz. *Populus nigra* and *Toisusu cardiphylla* there are 19 bivalents in PMCs., among which the author could distinguish an unequal pair of chromosomes.

In both genera the secondary association of chromosomes was frequently observed, and it may occur between the equal-sized as well as the unequal-sized chromosomes.

391. Cytological observations on some sugar cane varieties. (A preliminary note). (Japanese). Eitaro SUZUKI. (J. J. G. **16**, 1940, 276-278, 1 text-fig.).

Cytological observations of the meiosis of PMCs in certain sugar cane varieties cultivated in Formosa were made. Also *Saccharum spontaneum* L. which grows wild in Formosa was cytologically studied. In I-metaphase 48_{II} were seen, and the meiosis was quite regular.

392. On the relation between the difference of susceptibility of rice towards blast disease and the invasion of host body. (Japanese). Hashio SUZUKI. (A. H. **15**, 1940, 1999-2010, 2 text-figs.-groups).

Comparative studies on the variation in the number of epidermal cells of leaves of rice plant affected by rice blast disease fungus according to the difference of internal as well as external conditions were made.

That number, whatever kind of epidermal cells they may be, seems to be smaller in resistant than in susceptible strains, in the seedlings reared in moist than in dry soil, and further in mature than in young leaves of seedlings.

In any strain as well as in the seedlings reared in any soil the bulliform cells are those mostly affected. In this respect the following are arranged in descending order: long and short cells I on upper surface, accessory cells on the same, long and short cells II on the same, accessory cells on the underface, and long and short cells on the same.

The more thickened the outer membrane of epidermal cells, the better developed their silicated outermost layer, and the more numerous the silicated stomata, the less the number of affected cells.

The number of affected accessory cells does not necessarily go parallel to that of stomata per unit area, but it is inversely proportional to the thickness of outer walls of silicated accessory cells and to the number of silicated stomata.

393. Relation between the resistance of the internodes in the panicle neck of rice plant against blast disease and their anatomical structure. (Japanese). Hashio SUZUKI. (A. H. **15**, 1940, 2193-2199, 2387-2394, 3 text-figs. and 2 text-figs.-groups).

The anatomical structure of the internode in the panicle neck of rice plant is as follows: its cross-section shows under the epidermis very thick-walled sclerenchyma and soft green parenchyma alternating. The part of the epidermis covering the sclerenchyma is destitute of stomata (stomaless stripe) and is provided with a number of short silicated cells, while that covering the green parenchyma carries stomata (stomatal stripe).

The results of the author's infection experiments are briefly as follows: (What is simply called epidermal cells below refer always to those in the internode of the panicle neck):

The conidia of blast disease fungus are able to form appressoria upon any epidermal cell; it can also penetrate within it through its outer wall, except short silicated cells in the stomaless stripe.

The thickness of outer wall of epidermal cells and of the outermost layer of silicified outer wall, as well as the number of short silicated cells seem to be greater in plants grown in moist than in those reared in dry soil. The above characters seem to be closely connected with the invasion of the blast fungus, inasmuch as the more developed are they, the less intense its invasion. The number of stomata per unit area seems to be greater in plants grown in moist than those grown in dry soil. In the former case there is no special difference between susceptible and resistant strains in respect to their susceptibility.

The number of epidermal cells which are subjected to the fungus invasion is smaller in plants grown in moist than in those grown in dry soil. Long cells in the stomaless stripe are more susceptible to the attack of the fungus than long and short cells in the stomatal stripe as well as accessory cells of stomata.

When the fungus invasion occurs through long and short cells in the stomatal stripe, the infection will take place more surely than in the case when the invasion is through long cells in the stomaless stripe. In respect to the invasion through the stomatal stripe the nearer the spot of invasion to stomatal openings, the more probable the occurrence of infection.

394. *Hymenophyllum blandum* RACIBORSKI, new to the flora of Taiwan. (Japanese with English résumé). SUZUKI-Tokio. (J. Jap. B. **16**, 1940, 480-483, 1 figs.-group).

The species of *Hymenophyllum* which is cited in the above title was discovered in Formosa in 1939 by the author as an epiphyte on the bark of *Chamaecyparis*, about 1000 m above sea level.

395. ***Scleroglossum pusillum*** **v. A. v. ROSENB.** (Japanese with English résumé). SUZUKI-Tokio. (J. Jap. B. **16**, 1940, 484-487, 1 figs.-group).

The fern in the above title which was discovered in Formosa by the author lives epiphytic and is adapted to the special type of Laurisilvae, *Rhododendron formosanum* association, and is never found in the climax forest of *Shiia digitata* alliance.

396. ***Polystichum*** **of Japan, Korea, and Formosa. I.** Motozi TAGAWA. (A. PT. G. **9**, 1940, 119-138).

The genus *Polystichum* is divided into 8 sections. Sect. 1 Cyrtomiopsis TAGAWA contains 1 species, Sect. 2 Mastigopteris TAGAWA 1 species and 1 variety, Sect. 3 Achroloma 2 species, sect. 4 Crucifix TAGAWA 3 species and 2 varieties, sect. 5 Sorolepidium (CHRIST) TAGAWA 1 species and 1 variety, sect. 6 Eupolystichum DIELS emend. 1 species, sect. 7 Haplopolystichum TAGAWA (with a key) 7 species and 2 varieties, sect. Metapolystichum TAGAWA 1 species.

397. Studies on Formosan ferns 2-3. (With Japanese résumé). Motozi TAGAWA. (A. PT. G. **9**, 1940, 139-148, 203-215).

The following new species are contained in the present paper: *Mecodium taiwanense*, *Crepidomanes nanophyllum*, *Dryopteris pseudolunanensis*, *D. subatrata*, *Ctenopteris subcorticola*.

398. On the development of the conceptacle of ***Sargassum***, ***Coccophora*** **and** ***Cystophyllum*****.** Masato TAHARA. (Sc. Rpts., T. I. U. **15**, 1940, 321-330. 7 text-figs.).

Notwithstanding earlier studies of Fucaceae by SIMONS (1906) and NIENBURG (1913) there remain some important genera which are needed to be investigated in respect to the conceptacle development.

The author's present paper is concerned with the same subject in *Sargassum*, *Coccophora* and *Cystophyllum*. In early stage the mode of the conceptacle development agrees perfectly to each other in all three genera. Since the mode of development in *Sargassum enerve* and *Horneri* as announced by the author, has been already reviewed in this JOURNAL (**11**, (73), No. 248), it will not be repeated here.

In *Coccophora Langsdorffii* the behaviour of the tongue-cell in later stage is quite different from what we see in *Sargassum*, because it divides transversely and takes the form of a typical paraphysis. In early stage few wall-cells elongate towards the central cavity of the conceptacle and become the paraphyses by transverse divisions. In the mature conceptacle a multitude of slender paraphyses are observed, each of which is made up of a number of flattened cells and are therefore quite different from the primary paraphyses cited above.

In *Cystophyllum sisymbrioides* the mode of arrangement of cells resulting from repeated cell-divisions of the lower cell originally derived from the initial cell is different from that seen elsewhere: in *Coccophora* and *Sargassum* these cells are arranged radially around the central tongue-cell, but in *Cystophyllum* the cell-walls are so arranged so as to cross each other mostly at right angle. In this species the mode of closure of the conceptacle mouth is quite peculiar, inasmuch as it is not worked out by the tongue-cell, but by certain cells of the epidermal tissue which grow out in a later stage.

399. Embryogeny of *Torreya nucifera* S. et Z. Masato TAHARA. (Sc. Rpts., T. I. U. **15**, 1940, 419-426, 2 pls., and 7 text-figs.).

In *Torreya nucifera* the meiosis of PMCs takes place in late April, while the tetrad formation of the embryo-sac mother-cell occurs at the beginning of June. Fertilization takes place in the middle of August and is followed immediately by the embryonal development. The latter process, however, stops after a certain time, and first in the next year, i.e. after overwintering, it is completed. This fact is rather remarkable, as the author says, because in the majority of Conifers the fertilization and the completion of the embryogeny occur in one and the same year.

In the meiosis of PMCs 11 bivalents are counted, one of which is distinguished by showing a secondary constriction (12 chromosomes in *Taxus* and *Cephalotaxus*).

In the pollen-tube a tube nucleus and a stalk cell nucleus are formed, and two sperm nuclei of unequal size are developed, which are embedded in a common cytoplasm. Each sperm nucleus is smaller than the egg nucleus.

The number of archegonia in each ovule is generally three. The division of the central nucleus of the archegonium gives rise to the ventral cell nucleus and egg nucleus, and the former soon degenerates without the cell formation. The fusion nucleus after fertilization undergoes three simultaneous divisions to give rise to 8 nuclei. The cell division then occurs, and the proembryo is formed at the base of the egg cell. The cells of the former are arranged at first in two tiers, and then it becomes composed of three tiers, of which the cells of the middle elongate considerably to form the prosuspensor. In the second year four embryonic initials are usually formed at the end of the prosuspensor, and each of them develops into an independent embryo, the so-called the cleavage polyembryony. In the embryo development no primary suspensor is observed, but the secondary suspensor consisting of numerous embryonal tubes, which are directly connected to the extremity of the prosuspensor, are seen.

400. Embryogeny of *Podocarpus Nagi*. (Japanese). Masato TAHARA. (B.Z. **9**, 1940, 37-40, 6 text-figs.).

In *Podocarpus Nagi* the author could get a preparation at the stage of the copulation of the male and egg nuclei, and the specimen was collected in the middle of July. Nearly at the same period the central nucleus in the pollen tube divides to form two sperm-nuclei of unequal size, the smaller one going soon to degeneration.

In *Podocarpus Nagi* five nuclear divisions take place before the beginning of cell-wall formation, so that 32 free nuclei are seen assembled at the base of each archegonium. After the cell-wall formation the cells are arranged in two tiers. The upper contains about 25 cells which have no cell-wall on the side towards the centre of the archegonium, while the lower contains only about 7 cells which are walled all around. Through the sixth nuclear division after the fertilization each cell gets two nuclei. The cells of the upper tier which are now completely walled, elongate considerably and penetrate into the endosperm, taking a tortuous course and forming a suspensor composed of about 25 cells. The cells at its apex then begin to develop into the embryo, and in this case there are a number of the embryo initials, each of which develops into an independent embryo—the cleavage polyembryony.

401. On the inheritance of the colour of the stem and fruit in *Panax Ginseng* C. A. MEYER. (Japanese). Noboru TAKAHASI and Tosio OSUMI. (J. J. G. **16**, 1940, 273-276, 1 text-fig.).

Normal individuals of *Panax Ginseng* are distinguished by their dark purple stem and fresh red fruit. Recently two plants with green stem and fresh yellow fruit

and one with green stem and fresh red fruit were discovered among more than 2000 plants. The culture of their next generation as well as the crossing have shown that green stem is either perfectly dominant or recessive to dark purple, and further, that the former is always accompanied by red fruit, and the latter by yellow fruit. Basing on these results the authors have assumed the existence of the factor P for the anthocyanin and the inhibiting factor H in respect to the manifestation of stem and fruit colour in this plant.

402. Beziehung zwischen den Pflanzenvereinen der Sanddüne und den wesentlichen Elementen des Bodens bei Niimiyahama in der Hukuoka Präfektur. (Japanisch). Torata TAMAI und Makoto TAKENOUCHI. (B.S., K.I.U. **9**, 1940, 96-108, 3 Textfig.).

Niimiyahama ist ein Teil der ausgedehnten Sanddüne beim Meeresstrand im nördlichen Teil der Hukuoka-Präfektur, Kyûsyû. Es ist merkwürdig, dass dabei man zwischen der Hochwassergrenze und des davon ±200 m nach innen entfernten Landstückes drei verschiedene bandförmige Pflanzenvereine unterscheiden kann. Beim ersten davon, welchen die Verff. den Vorsanddünen-Pflanzenverein nennen und welcher sich von der Hochwassergrenze aus bis zu ±70 m nach innen ausdehnt, wachsen hauptsächlich psammophile Kräuter, wie *Carex macrocephala* var. *Kobomugi*, *Lactuca repens*, *Fimbristylis sericea*, *Zoysia macrostachya*. Im zweiten Pflanzenverein, welcher vom Ende des ersten zum Anfang des *Pinus Thunbergii*-Waldes ausdehnt, beobachtet man etwa mesophytisch psammophile Pflanzen, wie *Crotalaria sessiliflora*, *Lespedeza pilosa*, *Digitaria ciliare*, *Artemisia capillaris*, *Lathyrus maritima*. Der dritte Verein besteht vorwiegend aus dem Walde von *Pinus Thunbergii*.

Die Resultate der Verff.s Untersuchungen über den Salzgehalt und das pH-Verhältnis des Bodens bei jedem obengenannten Verein sind in einer Tabelle zusammengestellt. Danach nimmt der Salzgehalt (hauptsächlich NaCl) aus dem Meeresstrand nach innen schnell ab auf die Bodenfläche. Auch bei jedem Verein kann man die Eigentümlichkeit der Salgehaltsweise wahrnehmen, so z.B. beim ersten Verein ist die Sandschicht sowohl im oberflächlichen als im unterirdischen Teil des Bodens salzreich, während bei dem zweiten sie verhältnismässig salzreicher im oberflächlichen als im unterirdischen Teil ist. Weiter, beim dritten ist die Sandschicht an beiden Teilen salzarm. Bezüglich der pH-Konzentration nimmt man das gleichartige Verhältnis wie bei dem obengenannten Salzgehalt wahr, da pH schnell nach innen abnimmt.

Man kann sagen, dass der Salzgehalt sowie die pH-Konzentration des Bodens eine wesentliche Rolle bei der Entstehung von drei obengenannten Pflanzenvereinen spielen müssen.

403. *Phytophthora macrospora* (SACC.) S. ITO et I. TANAKA on wheat plant. (Japanese with English résumé). Ichiro TANAKA. (A.PP.S.J. **10**, 1940, 127-138, 7 textfigs.).

In respect to *Phytophthora macrospora* causing downy mildew of wheat the oospore only has been known, until TASUGI came to discover its conidial stage in rice plant. The author was able to see recently, not only the conidial stage of the fungus in wheat, but also oogonia, antheridia, and oospore. The data of measurement of their size are given.

The author's observations led him to the following conclusion regarding the nomenclature: *Phytophthora macrospora* (SACC.) S. ITO et I. TANAKA n. comb.=*Sclerospora macrospora* (SACC.) HEDW.=*Scl. Krugeriana* MAGN.=*Scl. Oryzae* BRIZI.

404. Chromosome studies in Cyperaceae VIII. Meiosis in diploid and tetraploid forms of *Carex siderosticta* HANCE. Nobunori TANAKA. (Cyt. **11**, 1940, 282 310, 55 text-figs.). — **IX. Structural hybridity observed in meiosis of *Carex lanceolata* BOOTT.** (With Japanese résumé). By the same author. (B. M. T. **54**, 1940, 378-388, 1 pl. and 34 text-figs.).—**X. Aneuploid plant of *Carex multifolia* OHWI.** (Japanese with English résumé). By the same author. (Ibid., 433-446).—**XI. Meiosis in *Carex duvaliana*.** By the same author. (Jap. J. B. **11**, 1940, 213-219, 1 photo. and 13 text-figs.).

Ad VIII.—The author has got *Carex siderosticta*, either as a diploid (2n=12) or a tetraploid (2n=24) form. The meiosis in the former was quite regular. In the latter there are in I-metaphase, besides the bivalents and the tetravalents, a few univalents and various associations consisting of 3, 5, 6, 7, 8, 9 and 14 chromosomes respectively. Among 733 PMCs studied by the author the percentages of the bivalents and the tetravalents were 50.10 and 47.21 respectively, and those of all others were lying between 0.08–0.99. Thus the bi- and the tetravalents were present in the great majority, and very few univalents were seen, and the rest are concerned in the formation of the multivalents. The above facts led the author to the conclusion that he had here to deal with an autotetraploid. The meiosis of the tetraploid is distinguished by the irregular separation of the multivalents, and on account of such irregularity about 30% of the gametes are unbalanced with the consequent reduction in fertility.

Ad IX.—The author's own summary runs as follows:

Structural hybridity in meiosis in *Carex lanceolata* BOOTT has been observed, and its significance for the aneuploidy in *Carex* has been discussed. At I-metaphase several modes of pairing have been observed and in some plates either univalents or multivalents were observed. Irregularities seen at I-metaphase are of a small degree as the whole, but they are seen from cell to cell.

Chromosome distributions at PM were carefully observed and the alteration of the chromosomes was also analyzed. As a whole, structural hybridities in the present case lead to the loss of chromosomes. Considering from the chromosome behaviour in meiosis it has been suggested that this species is a secondary balanced octoploid.

Ad X.—In *Carex multifolia* five different kinds of somatic chromosome number were discovered, viz 30, 60, 64, 65 and 66 The meiosis in each case has been observed in respect to PMC.

In plants containing 2n=30 (diploid) and 2n=60 (tetraploid) 15 and 30 bivalents were seen respectively, and the meiosis was normal. Plants containing 64, 65 and 66 (hypertetraploid) are considered to have been originally derived from the autotetraploid (2n=60), which has been discovered in fact by OKUNO some time ago. The chromosome number of hypertetraploids 64, 65 and 66 should have come into existence owing to two steps, viz. doubling of the chromosome set and appearance of hypertetraploid, i.e. $2\times30+x(4, 5 \text{ or } 6)$. In plants 2n=64 the meiosis is normal and it should be considered as a balanced derivative of the tetraploid. In plants 2n=65 or 66, on the contrary, the meiosis is accompanied by some structural hybridities, and they should be considered as the unbalanced derivative of the tetraploid.

405. Damping-off of seedlings of Chinese *Aster* and *Zinnia*. (Japanese with English résumé). H. TASUGI and H. SIINO. (A.PP.S.J. **10**, 1940, 279-293, 5 text-figs.).

A new fungus which is considered as *Pythium megalocanthum* var. *callistephi* is parasitic on *Callistephus chinensis* and causes the damping-off. Its diagnosis is given. It grows well on oat meal and potato agar. Temperature for its growth lies between 10° and 29°, optimum 23°.

A species closely related to *Pythium spinosum* causes the damping-off on *Zinnia*

elegans and several others. It grows best on potato or bean agar and between 8–35°, optimum 24°.

406. Physiological studies of the rice plant with special reference to the crop failure caused by the occurrence of unseasonable low temperature (I). The scope and experimental methods of the studies. (Japanese). Hirosi TERAO. (P. C. S. S. J. **12**, 1940, 169-176, 5 figs.). — **(II) Panicles affected by low temperature at different stages of their differentiation.** (Japanese). Hirosi TERAO, Yosio OTANI, MINORU SIRAKI and Masae YAMASAKI. (Ibid., 177–195, 8 figs.). — **(III) On the impotency of pollen and pistils under low temperature.** (Japanese). Hirosi TERAO, Yosio OTANI, Yataro DOI, and Zyuku TYO. (Ibid. 196–202, 4 figs.). — **(IV) Varietal differences of rice in regard to the anthesis and fertilization under low temperature.** (Japanese). Hirosi TERAO, Yorimi KONDO, Yataro DOI, and Seiiti Izumi. (Ibid. 203–208, 2 figs.). — **(V) Anthesis and fertilization as affected by the low temperature treatment on heading.** (Japanese). Hirosi TERAO, Yosio OTANI and Yataro DOI. (Ibid. 209-215, 2 figs.). — **(VI) Fertilization in the spikelets subjected to the low temperature treatment after flowering.** (Japanese). Hirosi TERAO, Yosio OTANI, Yataro DOI, Zyuku TYO and Tuneo HUZIWARA. (Ibid. 216-227, 4 figs.). — **(VII) Photosynthetic efficiency of rice varieties.** (Japanese). Singo MITUI. (Ibid. 228-232, 2 figs.).

The north-eastern regions of Japan suffer not rarely from poor harvest of rice, owing to unseasonable low temperature, and this was also the case in 1940. To avoid such crop failure as much as possible in future, the arrangement was made from 1935 in the Central Agricultural Experiment Station of Tokyo and its several branch stations for studying the fundamental problems of physiology concerning the matter. Experiments which were already begonnen are continued till now and will be further performed in future. A series of papers above cited are devoted to the description of the experimental results hitherto obtained in preliminary form. The experiments consist chiefly in studying the damaging influence of low temperature in various stages of the panicle development.

One of the experiments consists in subjecting the panicle to 17°C during six days at the period extending between the beginning of its development and the heading from time to time. The greatest effect of this treatment was seen at the stage nearly 24 days (when stamens and pistils are concerned in differentiation) and 10–14 days (when the germ-cells are being differentiated) before heading respectively. The results of this treatment are the decrease of the number of the pollen grains on the whole and the proportional increase of that of sterile ones. In another experiment pollen grains were placed artificially on the stigma, and it was seen that at 27°C their germination begins to take place only after 5 min, and 1 hr. all grains were emptied of their content. The minimum temperature for the above process was observed to lie between 10–13°C. The damaging influence of low temperature was seen to be much greater in pollen than in pistil.

When the plant is subjected to 17–18°C one day before its heading a number of flowers remain unopened in varying proportion in various strains.

In still another experiment the plant was subjected during its heading stage to 15°C, firstly from the evening (6 o'clock p.m.) of the day of the opening of the first flower onwards, and secondly, from the next morning (8 o'clock a.m.) onwards and the plants remained under low temperature during 4 days. It was observed that the flowers remained unopen during the whole duration of the experiment in the first case, but in the second some flowers begin to open as the time elapses on. The rate of

fertilization was lowered, and the longer the time duration of the treatment, the lower that rate.

Flowers are subjected to 15° during 20–45 hrs. 10–99 min. after their natural opening the influence of such treatment was studied. When the low temperature treatment is executed within 30 min. after flowering the rate of fertilization suffers a considerable diminution. The same treatment after 30 min. leads, on the contrary, to the sudden increase of the rate, and that after 60 min. has no effect whatever. The fertilization of flowers subjected to 15°C during 45 hrs. is much retarded or even inhibited, but the recovery sets in gradually at the return of normal temperature.

Seedlings were reared partly out-of-doors at 25–29°C, partly within a cold chamber at 18°. Such plants were placed under 24.2° and 14.2° respectively and the weight of CO_2 absorbed by an unit area of the fifth leaf of each plant was measured. It was then quite naturally observed that the photosynthesis is less intense under the latter than under the former temperature. But it will be noticed that the difference of the intensity of assimilation under these two temperatures is much smaller in plants reared under 18° than those reared under 25–29°. This fact should be considered as an adaptation of plants to low temperature. Further, the author has observed that in respect to one strain called Nôrin No. 3 the intensity of assimilation is extremely variable in different cases, and this is attributable to the influence of the different situation of leaf on the culm as well as on its different age.

407. Internal formation of conidia of the rice blast disease. (With Japanese résumé). Mutsu TERUI. (A. PP. S. J. **10**, 265–267, 1 pl.).

In rice blast fungus the conidiophore with its conidia was considered hitherto to be developed exclusively on the surface of epidermal cells of the host plant. But recently the internal development of conidia has been recognized, and the fact has been studied by the author. In leaf-blades, leaf-sheaths as well as the necks of the panicle the microscopical examination of their sections has shown that the hyphae grow profusely in the hollow cavities and form the conidia, which are able to germinate in situ. The conidia produced in hollow cavities are easily identified by being shorter and wider than those developed externally.

408. Studies on the synthetic nutrient solution suitable for the mycelial growth of *Piricularia Oryzae*. (Japanese with English résumé). Yoshihiko TOCHINAI and Tomio NAKANO. (A. PP. S. J. **10**, 1940, 110–118).

In the nutrient medium hitherto used ordinarily for the culture of *Piricularia Oryzae* no rich development of the mycelium does take place. In the present paper the authors give the formula for a better nutrient solution, viz. KNO_3 2g, KH_2PO_4 and K_2HPO_4 each 0.5 g, $CaCl_2$ 0.1 g, $FeCl_3$ trace, sucrose 30g, water 1000.

409. New species of parasitic fungi II. (With Japanese résumé). Kogo TOGASHI and Yukio MAKI. (A. PP. S. J. **10**, 1940, 139–140, 1 pl.).

The following new species are described: *Contractia obovoidea* TOGASHI et MAKI sp. nov. in the ovaries of *Carex Fernandianae*, *Sorosporium Kumanoanum* TOGASHI et MAKI, sp. nov. in the ovaries of *Bulbostylis barbata*, *Ustilago Moehringia* TOGASHI et MAKI, sp. nov. in the ovaries of *Moehringia platyspermae*.

410. On the purple sulphur bacteria and the purple athiobacteria found in some brackish water lakes in Japan. (With Japanese résumé). Shozo TOKUDA. (B. M. T. **54**, 1940, 298–302, 321).

The author's own summary runs as follows:

The author has found the purple sulphur bacteria and the purple athiobacteria

in the water of the lower layer, 6 m below the surface of Lake Hamana, Lake Suigetu and Lake Harutori among other brackish water lakes in Japan producing hydrogen sulphide in their bottom. The species belonging to the *Chromatium* found in these lakes are *Chromatium globosum* TOKUDA, sp. nov., *Ch. spadix* TOKUDA, sp. nov. and *Ch. minus* WIDNOGR., and the species belonging to the purple athiobacteria is *Rhodospirillium brevis* TOKUDA, sp. nov.

411. Polyploidy and secondary pairing in the genus *Veratrum*. (Japanese with English résumé). Nobumi TOKUMOTO. (B. Z. **8**, 1940, 1189–1195, 15 text-figs.).

Among the genus *Veratrum*, *V. nigrum* var. *japonicum* and *V. longibracteatum* are diploid (2n=16). In studying the I-metaphase of PMC it was observed that 1 bivalent lies inside and the remaining 7 bivalents outside, which is in accordance with the floating magnet theory of chromosome arrangement.

In *V. oxysepalum* which is tetraploid (2n=32) the secondary pairing of two bivalents was observed, especially when the material was treated with low temperature. It is remarkable that the groups of secondarily associated bivalents behave as single bodies and are mostly so arranged as to conform to the floating magnet theory of the chromosome arrangement.

412. Orchidaceae novae micronesicae, II-IV. (With Japanese résumé). Takasi TUYAMA. (B. M. T. **54**, 1940, 261–272, 273–280, 295–298, 1 pl. and 3 text-figs., 282–288, 289–292, 319–321).

The following new species are described among others: *Agrostophyllum kusaiense, Bulbophyllum desmanthum, B. Hatusimanum, B. kusaiense, Cestichis Yamadae, Corymbis trukensis, Eria Uchiyamae, Hetaeria Ogurae, Liparis palawensis, Oberonia ponapensis, Peristylus setifer, Phreatia landronica, Ph. pseudo-Thompsoni, Nervilia ignobilis, Thrixspermum ponapense.*

All are fully described with illustrations.

413. A new orchidaceous plant from Taiwan. (With Japanese résumé). Takasi TUYAMA. (J. Jap. B. **16**, 1940, 523–526, 2 text-figs.).

Thrixspermum xanthanthum TUYAMA, sp. nov. (Sect. Dendrocolla) is described in detail and illustrated.

414. Lebendbeobachtungen über die Einwirkung des Colchicins auf die Mitose, besonders über die Frage der Spindelfiguren. Bungo WADA. (Cyt. **11**, 1940, 93–116, 48 Textfig.).

Obschon der Mechanismus der Polyploidbildung bisher vielfach untersucht worden ist, beachtete man dabei kaum das Verhalten der Spindelfigur, und viele nehmen einfach an, dass sie durch die Einwirkung der Colchincinlösung verschwinden soll. Die im vorliegenden Aufsatz erläuterten Resultate der Lebendbeobachtung des Verfs. bezüglich der Einwirkung der Colchicinlösung untergeworfenen Staubfadenhaarzellen von *Tradescantia* mögen wohl zur Berechtigung solcher irrigen Annahme dienen.

Dabei wurde es vor allem festgestellt, dass die Colchicinlösung unter einer bestimmten Konzentration ausschliesslich auf das Atraktoplasma und kaum auf die anderen Teilungselemente einwirkt. Eine wichtige Tatsache ist, dass sie auf die Lebensfähigkeit der Zellen gar keinen schädigenden Einfluss ausübt. Freilich kann man ziemlich leicht die Ausbildung der Polyploidkerne durch den Gebrauch vieler Chemikalien, z. B. Chloralhydrat, Essigsäuredampf, Acenaphthen usw. veranlassen, doch können sie keineswegs die Polploidzellen ausmachen, wie die Colchichinlösung

tatsächlich es tut, indem solche Chemikalien nicht nur auf die Spindeltätigkeit, sondern auch auf die Lebenstätigkeit der Zellen schädigend einwirkt, um das Leben derselben unmöglich zu machen.

Inbezug auf die Einwirkungsweise des Colchicins auf das Atraktoplasma ist es angenommen, dass es in den teilenden Zellen als oberflächenaktive Substanz wirkt und die Grenzspannung des Atraktoplasmas herabsetzt. Viele in den vorliegenden Experimenten beobachteten Erscheinungen kann man auf Grund dieser Annahme erklären.

Unter den durch die Colchicinlösung veranlassenden Erscheinungen gibt es z.B. das Erweitern des Atraktosoms, welches die Zerstreuung der Chromosomen im erweiterten Raum desselben verursacht, was auf die Verminderung des bisher ausgeübten regulierenden Druckes seitens der Spindel hinweist.

Eine weitere eigentümliche Erscheinung ist das Stattfinden der Chromosomenverdoppelung, schon in der späten Prophase ohne dem Eintritt der Metaphase.

Trotz der Veränderung des Atraktoplasmas bei der Colchicin-Einwirkung ist eine Grenzfläche zwischen dem letzteren und der Phragmoplast-Substanz einerseits und dem Zytoplasma anderseits vorhanden, und die zerstreuteten Chromosomen werden vom Atraktoplasma umgeben.

Der Abbau des Atraktoplasmas setzt parallel mit der Chromonematisierung der Chromosomen ein; es zytoplasmatisiert sich, d.h. es verflüssigt sich zur granulareichen, flüssigen Plasmamasse, um schliesslich mit dem Zytoplama der Mutterzelle zusammenzufliessen.

415. On the influence of hydrogen ion concentration on the development of the atrophic fire-blight disease of the udo salad plant. (Japanese with English résumé). Tatuwo WATANABE. (A. PP. S. J. **10**, 1940, 186-191).

The author has studied, whether the pH of the juice of leaves and stems of the udo salad plant (*Aralia cordata* and some other species of *Aralia*) will have any relation to the attack of *Phoma Araliae* COOKE et MASSEE var. *microspora* WATANABE causing the atrophic fire-blight disease. The result was negative, i.e. no relation was observed between the pH-concentration of the plant juice and the attack by the fungus.

416. Anatomical studies on the leaves of some saxifragaceous plants, with special reference to the vascular system. Shunji WATARI. (J. F. S., I. U. T. Sec. III, **5**, 1939, 195-316, 26 figs., 12 photos.)

The manner of departure of the foliar traces, their course in the petiole and lamina, as well as certain histological features, such as the woody part, pericycle and starch sheath, together with additional remarks on some external morphological features of the leaves are described and discussed in detail upon the basis of 10 subfamilies of the Saxifragaceae. For example, the vascular systems are divided into seven types with reference to the relative position of the bundles derived from the various original traces, the form of bundles, the formation of the ventral bundle and medullary systems, and the manner of formation of the nerve bundle. None of these types, however, are independent; there are some delicate and intimate relationships with one another, the contacts among the types being discussed in detail. The characteristic features of the vascular system in connexion with unifacial, subunifacial and bifacial structures of petiole could scarcely be discerned. Some important external morphological and anatomical features are shown in a table. Author.

417. Species of *Caulerpa* in South Sea Islands. (Japanese). Yukio YAMADA. (Sc. S. S. I. **3**, 1940, 95-107, text-figs.).

Caulerpa fastigiata MONTAGNE, *C. verticillata* J. AGARDH, *C. filicoides* YAMADA, *C. Webbiana* MONTAGNE, *C. brachypus* HARVEY, *C. sertularioides* HOWE, *C. antoensis* sp. nov., *C. serrulata* (FORSK.) J. AGARDH, *C. Urvilliana* MONTAGNE, *C. cupressoides* AGARDH var. *Turneri* WEBER VAN BOSSE, *C. racemosus* J. AGARDH var. *clavifera* WEBER VAN BOSSE, var. *uvifera* J. AGARDH, var. *Lamourouxia* WEBER VAN BOSSE, var. *laete-virens* WEBER VAN BOSSE, var. *Chemnitzia* WEBER VAN BOSSE, var. *corynephora* WEBER VAN BOSSE, *C. peltata* LAMOUROUX, *C. lentilifera* J. AGARDH, *C. Matsuzana* sp. nov.

All are described and illustrated.

418. Über einige Anomalien bei *Portulaca grandiflora*. (Japanisch). Yasuke YAMAGUTI. (J. J. G. **16**, 1940, 307-308, 3 Textfig.).

Unter den F_2-Nachkommen der Kreuzung gewisser Sippen von *Portulaca grandiflora* untereinander hat der Verf. die folgenden Anomalien beobachtet.

Die gelbgrünen Pflanzen, welche schwächlich und doch vollkommen fruchtbar sind, verhalten sich rezessiv gegen die normalen grünen Pflanzen.

Bei den Pflanzen, deren Stämme flach sind und mit längsverlaufenden linienartigen Erhebungen versehen sind, geschieht die Spaltung, normal mit rundlichen Stämmen: anormal mit flachen Stämmen ungefähr zu 5:1, d.h. Spaltungsverhältnis mit zu wenigen anomalen Sippen auf monogenischem Grunde.

Die Zwergpflanzen, welche durch Selbstung fast vollkommen unfruchtbar sind, haben durch die Bestäubung aus der normalen Pflanze wenige Nachkommen angegeben und dabei kann man die völlige Dominanz der normalen über diese anomale Sippe feststellen.

419. On a brown sooty mould, *Phaeosaccardionala javanica* (ZIMM.) comb. nov. on persimmon. (Japanese with English résumé). Wataro YAMAMOTO. (A. PP. S. J. **10**, 1940, 254-269).

In Formosa the author has found the persimmon, of which leaves are almost wholly covered by the sooty mould. His culture of this mould from the isolated single spore has shown that the sooty mould includes four different species from the genera *Phaeosaccardinula*, *Triposporium*, *Microxyphium* and *Popnodium*, of which the first was most prevailing. At the same time a number of scale insects were found to live together with such fungi on the same leaves, viz. *Tachardina*, *Pulvinaria*, *Pinnaspis*, *Toracaphis*, *Phyllaphoides* and *Trichoregina*.

420. Materials for a flora of the South-East rn Asia, including Formosa and Ryukyu, South China, Malay Archipelago and others. III. (With Japanese résumé). Yoshimatsu YAMAMOTO. (J. S. T. A. **12**, 1940, 243-250, 1 figs.-group).

Tinospora (1 sp.), *Stephania* (3 sp., of which *S. graciliflora* is a new species), *Paracyclea* (4 sp., of which *P. gracilima* is comb. nov.), *Cyclea* (1 sp.), *Callicarpa* (1 sp.), and *Nertra* (1 sp.) are contained in the paper.

421. On some new yeast types produced by hybridization. (Japanese). Yukio YAMAMOTO. (J. J. G. **16**, 1940, 302-304, 3 text-figs.).

The following crosses of *Saccharomyces* species were done:

S. Batatae×*S. shaoshing*
S. ellipsoideus×*S. shaoshing*
S. Batatae×*S. ellipsoideus*
S. shaoshing×*S. Hosigaki* (extracted from dried persimmon fruit).

In all cases above indicated the author could clearly recognize the heterosis phenomenon, for instance, concerning dry weight, power of fermentation, spore formation.

422. Studies on the transplantation of embryos in the Gramineae I. Method of transplantation. (Japanese). Yosito YAMASAKI. (P. C. S. J. **11**, 1940, 511-521, 6 text-figs.).

For studying various physiological problems concerning the relation between the embryo and the endosperm, it is necessary to transplant the embryo of the one species to the endosperm of the other. In this paper the method of taking off the embryo from the endosperm, its culture afterwards and sterilization, and certain apparatus for executing the transplantation are described.

423. Studies on the experimental production of fasciation in buckwheat by the treatment with heterauxin solution. (Japanese with English résumé). Yosito YAMASAKI. (J. J. G. **16**, 1940, 171–175, 3 text-figs.).

The author has immersed dry seeds and sometimes germinating ones of buckwheat in 1% heteroauxin solution during 5–60 hrs., or injected it into the top of germinating seeds. Two opposite leaves were then produced in the second node of the young plants which are normally provided with alternate leaves. Though the two opposite leaves are independent from each other in certain cases, in some others they fuse together by their petioles or even by their blades.

Such abnormalities increase parallel to that of the concentration of the heteroauxin solution used in the experiment.

Branches produced in the axils of the two opposite leaves of abnormal plants above announced are fasciated, though from the top of the fasciated branches normal ones are produced.

424. Cotton plants treated with colchicine. (Japanese). Kosuke YAMASHITA. (J. J. G. **16**, 1940, 267–270, 5 text-figs.).

The treatment of young seedlings of Indian cotton (n=13) by 0.10% colchicine solution gave flowers containing gigas pollen grains, but in upland as well as sea island cotton which are distinguished by the greater n-number (n=26) 0.2% solution must have been used for getting gigas pollen grains. Though both Indian and sea island cotton did not bear fruits, upland cotton gave two capsules, so that the following account refers exclusively to upland cotton. The root-tip cells of each of 3 individuals derived from them contained 52 chromosomes, and in the meiosis of PMC 26_{II} were formed, and it was quite regular. In other two individuals of the same derivation each root-tip cell contained 104 chromosomes, i.e. double normal number. In the latter case often the tetravalents were met with in the meiosis of PMC, and it was irregular.

425. Über den osmotischen Wert und das spezifische Pulvergewicht als Mittel zum Vergleich des Sukkulenzgrades der Pflanzen. (Japanisch m. deutsch. Zfg.). Tomoji YAMASHITA. (B. S., F. T., K. I. U. **9**, 1940, 35–43).

Die Zellsaftkonzentration und das spezifische Pulvergewicht zeigen beide, wie bekannt, den Grad der Menge der Wasserspeichernden Substanzen in den Pflanzen oder den Sukkulenzgrad an. Aber es ist eine unentschiedene Frage, welcher Zahlenwert der beiden Methoden für den Vergleich des genannten Grades zweckmässiger ist. Um diese Frage zu lösen, wurden das spezifische Pulvergewicht und der osmotische Wert

(Gefrierpunkterniedrigung) an den sukkulenten Organen der zu verschiedenen ökologischen Typen gehörenden, eine verschiedenstarke Sukkulenz zeigenden Materialien vergleichend bestimmt.

Es zeigte sich dabei, dass eine hohe positive Korrelation zwischen dem spezifischen Pulvergewichte und dem Sukkulenzgrad besteht, während die Zahlenwerte des osmotischen Wertes zur Vergleichung des Sukkulenzgrades der zu verschiedenen ökologischen Typen gehörenden Pflanzen ungeeignet sind, indem der Grad bei den sukkulenten Halophyten zu gross, bei solchen sukkulenten Xerophyten, welche die osmotisch unwirksamen aber wasserfesthaltigen Substanzen enthalten, zu klein erscheinen.

R. Kôketsu.

426. Studies on the thermal algae of Hokkaidô (3). (With English résumé). Y. Yoneda. (A. PT. G. **9**, 1940, 192–202).

The author has made in August 1938 the collection tour of thermal algae in various hot springs in Hokkaidô. The number of identified species was 34 with some varieties, which mostly belong to the Cyanophyceae with few Chlorophyceae and Diatomaceae. The author enumerates the species collected in each hot spring separately. Some species of the following genera of the Cyanophyceae were collected: *Cyanidium, Gloeocapsa, Synechococcus, Synechocystis, Oscillatoria, Phormidium, Chroococcus, Mastigocladus.*

Diatomaceae: *Achnanthes, Navicula, Pinnularia, Fragilaria.*

Chlorophyceae: *Ulothrix.*

427. Plant associations in "Yakebasiri" in Mt. Iwate. (Japanese). Yoshiji Yoshii and Kunizi Yosioka. (E. R. **6**, 1940, 319–326, 6 text-figs. and 5 tables).

A lava field called "Yakebasiri" on N-E slope of Mt. Iwate has taken its origin from lava flow at the time of its eruption in 1719. It is 4 km long and 1 km broad at the widest (lowermost) part. Though more than 200 years have elapsed since, it remains now yet almost quite free from the vegetation, except in some particular spots (s. below).

The place where lava blocks have accumulated thickly the moss *Rhacomitrium hypnoides* covers them and gives them whitish aspect.

Exceptional spots where the vegetation is observed are stabilized terrace which is somewhat elevated and provided with little soil, where plants can make only stunted growth and where trees can scarcely attain their full size and must remain shrubby; the depressions where the vegetation may perhaps prosper much more than in flat parts; the land patches, so to say, islands of vegetation, which remained untouched by lava flow at the time of eruption and is characterized by rich vegetation; the place which is adjacent to lava flow, which though not directly touched by it, must have suffered the intense heating at the time of eruption, and consequently is characterized by its proper vegetation.

428. Ecological studies of the peat bog (1). The peat bogs of Akamizusawa. (Japanese with English résumé). Yoshiji Yoshii and Kunizi Yosioka. (E. R. **6**, 1940, 173–195, 275–296, 17 text-figs. and 28 tables).

Akamizusawa is the name given to the peat bog formed in a gently sloping terrace at the elevation of 1000 m in the volcano Hakkôda. It is bounded on three sides by woodland and provided on both sides with marginal streams, of which the southern one is marked by water of alkaline or neutral reaction, and the northern by that of strong acid reaction. The types of plant communities are consequently very different

in these two parts; the northern is occupied by the *Sasa*-community and the scrub, while the remaining part is inhabited by different plant communities. In the latter area the Sphagnetum occupies the centre, and the Phragmitetum-community the lower part.

The most remarkable feature is the presence of small somewhat dry wood-island amidst the bog. The dominant tree is *Abies Mariesii* which is growing very insignificantly and even drying. Formerly its growth was pretty good, but since last 25 years it has begun to decline, and we may clearly infer it from the gradually decreasing thickness of annual rings. This fact may be attributable according to the authors to the accumulation of acid water in the ground as well as to the insufficient supply of oxygen on account of lack of drainage.

The authors' conclusion based on the results of their investigations in respect to the origin of the peat bog under question runs as follows: the forest which had developed on bare lava field decayed after a number of years, and at first the aquatic plants and the bog mosses invaded into numerous pools and lakelets, spreading far and wide over the surrounding vegetation, the more hydrophytic plants being succeeded by less hydroplytic ones and in the long run it reached the present aspect of bog plant communities with some relics of wood stands.

429. Studies in the cytology of Pteridophyta XX. The process of the formation of starch grains in the chloroplast. (With Japanese résumé). Akira YUASA. (B. M. T. **54**, 1940, 338-342, 4 text-figs.).

Formerly the author has published the results of his observation on the structure of the chloroplast. It is made up of the network of grana connected to each other by thin threads, both containing chlorophyll and embedded in the ground substance, and the whole is covered by a membrane. The assimilation starch is deposited around the grana and gradually thickens; sometimes one starch grain contains two or three grana. Further, in some cases two or three starch grains fuse together to form a large grain. When the chloroplast contains many starch grains the network breaks down and the grana become independent from each other, or even the network disappears. As the author remarks, the necessity of grana and connecting threads of the chloroplast for the accumulation of starch will be evident. (Cf. this Journal **10**, 465–475 and this Vol. (8), No, 371).

ERRATA in Vol. XI, No. 3

Page	Line	Read	Instead of
(101)	24	*aroideae*	*aroidea*
(105)	25 from below	in crosses	n crosses
(105)	24 from below	*Lilium speciosum*× *L. auratum, L. speciosum*×*L. Makinoi*	*Lilium speciosum, L. auratum, L. speciosum, L. Makinoi*
(112)	23	(2n=14)	(2n=24)

NOTICE

For binding Vol. XI the following order should be observed:

1. Title-pages and Contents of Vol. XI (at the end of Vol. XI, No. 4).
2. Transactions 1–146, 147–236, 237–383, 385–478.
3. Explanation of Abbreviations of the Journals' Names, etc. (before the Abstracts of Vol. XI, No. 4).
4. Abstracts (1)–(46), (47)–(81), (83)–(129), (131)–(167).

REMARKS.—Contents for each number of Vol. XI (1, 2, 3, 4) and Explanation of Abbreviations, etc. for No. 1, 2, and 3 of Vol. XI are not necessary for binding the Volume, because they are all contained in Contents at the end of Vol. XI, No. 4 and in Explanation of Abbreviations placed before the Abstracts of Vol. XI, No. 4.